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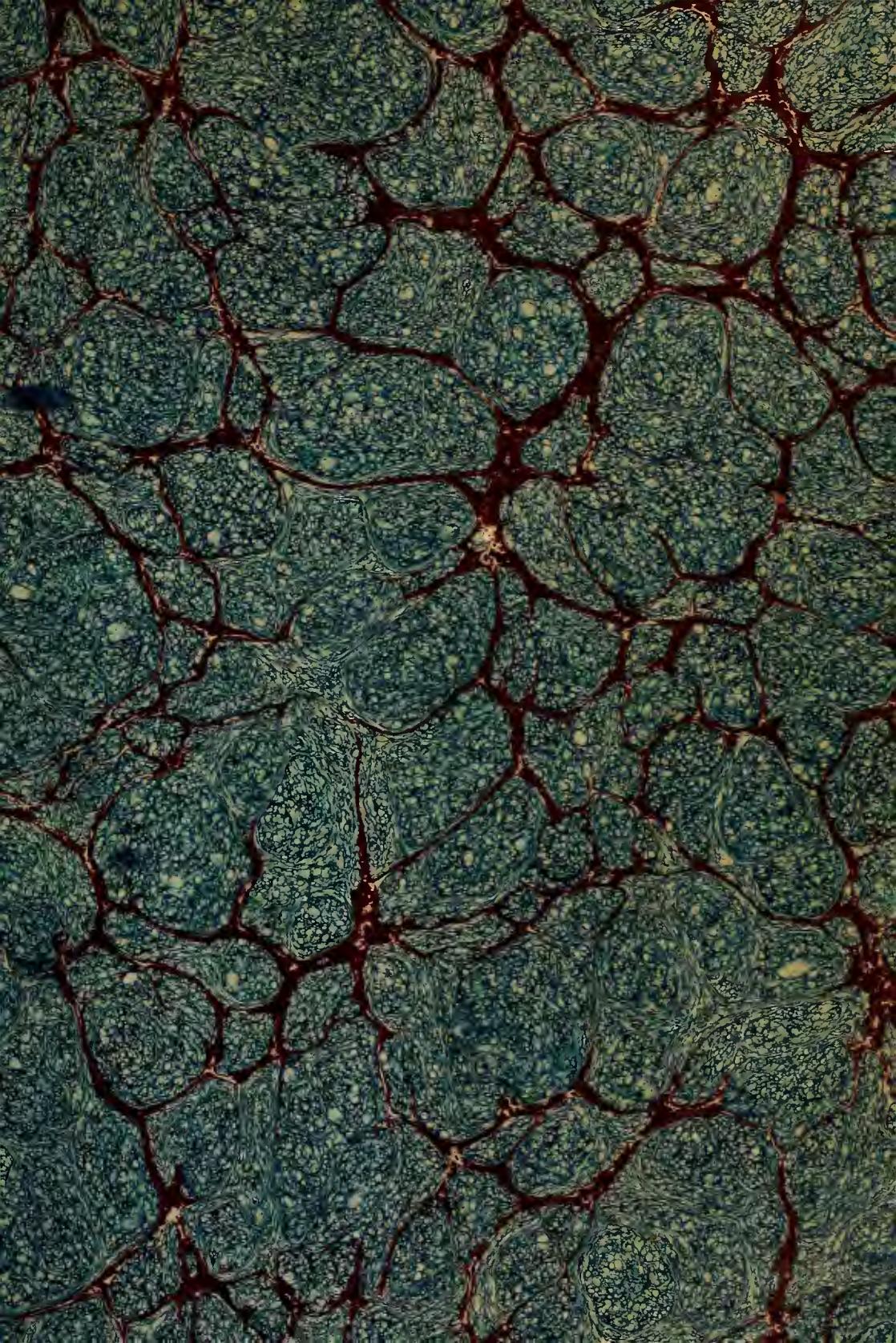
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OF

A S T R O N O M E R S.

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P A R T      I.

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ANCIENT ASTRONOMERS.

ABUL WAFA, Mohammed (959-998 A.D.) the last of the famous Bagdad school of astronomers, wrote a book named Almagest, a summation of Ptolemy's famous work of the same name.

ALBATEGNIUS, the Latinised form of the name of the Arab prince AL BATTANI (1st century A.D.) who drew up improved tables of the Sun and Moon. He discovered the motion of the solar apogee.

AL MAMUN (9th century A.D.) Caliph, erected a great observatory in 829, equipped with instruments superior to those of the Greek astronomers. He made a re-determination of the dimensions of the Earth.

AL-SUFI (903-986 A.D.) a Persian nobleman, compiled a catalogue of 1018 stars with approximate positions, magnitudes and colours. His Description of the Heavens was rediscovered and translated by Schjellerup in 1874.

APOLLONIUS (c. 250-200 B.C.) a native of Perge in Pamphylia, spent most of his life in Alexandria. One of the greatest of Greek mathematicians, he was the originator of the epicyclic theory of planetary motions, afterwards developed by Hipparchus and Ptolemy.

ARATUS (c. 310-250 B.C.) born at Soli in Asia Minor, became attached to the Macedonian court. He was the author of the Phaenomena, a poem based on a lost work of Eudoxus. This poem gives the oldest description of the 48 original constellations, and is of considerable historical value. Hipparchus wrote a commentary on it.

ARISTARCHUS (310-250 B.C.) born at Samos, was a skilful observer, who attempted to measure the distances of the Sun and Moon. He appears to have been the first to put forward the daring theory that the Earth rotates on its axis and revolves round the Sun.

ARISTILLUS (3rd century B.C.) one of the earliest practical astronomers of the Greek school of Alexandria, measured, in co-operation with Timocharis, the positions of the brighter stars on the celestial sphere, and thus made possible the discovery by Hipparchus, a century and a half later, of the precession of the equinoxes. He also made careful measures of the positions of the Sun and planets.

CALIPPUS (4th century B.C.) born at Kyzikus, was a pupil of Eudoxus and further developed that astronomer's theory of concentric spheres.



ERATOSTHENES (276-196 B.C.) a native of Cyrene, became librarian at Alexandria. He made the first measurement of the dimensions of the Earth. By means of observations with the gnomon he determined the difference of latitude between Alexandria and Syene, from which he deduced the Earth's diameter to be 7850 miles - a remarkable approximation to the truth.

EUDOXUS (c. 408-355 B.C.) born at Cnidus, went to Athens, where he attended the lectures of Plato. Later he spent some time in Egypt, but latterly resided in Sicily. He was the author of the theory of concentric spheres (the "homocentric spheres of Eudoxus") the first genuinely scientific attempt to explain the celestial motions.

HERACLEIDES (4th century B.C.) was born at Heraklea in Pontus, and settled in Athens. He was the first astronomer to explain the diurnal motion of the celestial sphere as apparent only and due to the rotation of the Earth on its axis.

HIPPARCHUS (2nd century B.C.) known as the "Father of astronomy" was born at Nicea, but spent the greater part of his life in the island of Rhodes. He appears to have begun observations in 161 B.C. He compiled the first star catalogue, containing the positions of 1080 stars. He discovered the precession of the equinoxes and investigated the motion of the Moon. He adopted the epicyclic theory of planetary motions first advanced by Apollonius, and further elaborated it.

KIDINNU (c. 380 B.C.) native of Babylon, was author of a method of computing solar and lunar positions and motions. He determined the maximum angular distance of Mercury from the Sun.

NABURIANNU (c. 500 B.C.) native of Babylon, determined the position of the equinox, and devised a system for computing solar and lunar elements.

NASSIR EDDIN (1201-1273 A.D.) born at Tus in Khorassan, worked for many years at the magnificently equipped observatory at Meraga in Persia. He had most of the Greek writings on astronomy translated into Arabic. He re-determined the precession of the equinoxes, and drew up new tables and a star catalogue.



POSIDONIUS (135-50 B.C.) observed at Rhodes, and attempted to measure the distance of the Sun. He re-determined the Earth's dimensions with less accuracy than Eratosthenes.

PTOLEMY, Claudius (2nd century A.D.) lived and worked at Alexandria. He revised the star-catalogue of Hipparchus, wrote a description of the Milky Way and discovered the inequality in the Moon's motion known as the evection. His greatest work, the Syntaxis, generally known by its Arabic name of the Almagest, was regarded in the Middle Ages as of almost supernatural authority. In it, he developed and perfected the epicyclic theory of the planetary motions, according to which the Earth, spherical and immovable, was the centre of the Universe.

TIMOCHARIS (3rd century B.C.) was a Greek astronomer of Alexandria, who, along with Aristillus, made the first accurate determination of star-places.

ULUGH BEGH (1394-1449 A.D.) grandson of the savage Tartar warrior, Tamerlane, erected about 1420 an observatory at Samarkand, Turkestan. He drew up new tables of the planets and compiled a star-catalogue, in which positions were determined with remarkable precision. He was assassinated in 1449.



P A R T      II.

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MODERN ASTRONOMERS.

ABBOT, Charles Greeley (1872- ) born at Wilton, New Hampshire, (U.S.A.), May 31, 1872, and educated at Massachusetts Technical College, became in 1895. assistant at, and in 1907 Director of, the Smithsonian Astrophysical Observatory. He has specialised in the study of the Sun, has determined the solar constant, and advanced sun-spot theories. His authoritative book on The Sun was published in 1911.

ABETTI, Antonio (1846-1928) born at San Pietro di Gorizia, (now in Italy), June 19, 1846, was educated at Padua University and became assistant in the Observatory there in 1867. His chief work was in spectroscopic astronomy, specialising in the study of the Sun. He was appointed Director of the Arcetri Observatory, Florence, in 1893. He retired in 1921, and died February 20, 1928.

ABETTI, Giorgio (1882- ) son of above, born at Padua, (Italy), October 5, 1882, and educated at Florence, became assistant at Rome in 1910 and succeeded his father in 1921. An authority on the Sun, he has measured the rotation of the various solar layers. He is the author of a standard work on The Sun (1936).

ADAMS, John Couch (1819-1892) born at Lidcot, Cornwall, (England), June 5, 1819, proceeded from his father's farm to a private school in Devonport, thence to Cambridge University, where he graduated in 1843. While still a student, he resolved to investigate the irregularities in the motion of Uranus, with a view to discovering a trans-Uranian planet. By 1845 he had computed the elements of the planet and fixed its place in the sky, and sent his results to Greenwich. As no adequate search was made in time, Neptune was first discovered as a result of Le Verrier's independent investigations; but Adams was immediately recognised as co-discoverer. From 1858 he was Professor of Astronomy at Cambridge and Director of the Observatory there. His later work was mainly on the Moon's motion and the Leonid meteors. He died January 21, 1892.

ADAMS, Walter Sydney (1876- ) born of American parentage at Antioch, (Syria), December 20, 1876, was educated at Dartmouth College and Chicago and Munich Universities. He was assistant at Yerkes Observatory (1901-1904) and joined the staff of the Mount Wilson Observatory in 1904. He became assistant Director in 1913 and Director in 1923. He has investigated the solar rotation, the atmosphere of Mars, stellar radial motions and many other branches of astronomy. His most striking achievement was his success, in co-operation with Kohlschütter, in determining the parallaxes of stars by spectroscopic means.



AIRY, George Biddell (1801-1892) born at Alnwick, Northumberland, (England), July 27, 1801, graduated at Cambridge in 1823. He was Professor of Astronomy at Cambridge from 1826 to 1835, when he was appointed Astronomer-Royal for England. He reorganised and modernised the Royal Observatory, Greenwich, and took part in eclipse and transit expeditions. He retired in 1881 and died January 2, 1892.

AITKEN, Robert Grant (1864- ) born at Jackson, California, (U.S.A.), December 31, 1864, was educated at Arizona and California Universities. Professor for four years in the University of the Pacific, he joined the staff of the Lick Observatory in 1895. Specialising in the observation of double stars, he discovered 31,000 new pairs and wrote a standard book on The Binary Stars. He became Director of the Lick Observatory in 1930 and retired in 1935.

ANDERSON, Thomas David (1853-1932) born in Edinburgh, (Scotland), February 6, 1853, was educated at Edinburgh University, where he graduated M.A., and later D.Sc. He qualified for the ministry of the Congregational Church but never held a charge and devoted his life to astronomy. With slender optical means he discovered over 50 variable stars and also the famous temporary stars Nova Aurigae (1892) and Nova Persei (1901). Resident in Edinburgh until 1904, he removed in that year to East Lothian and died at Edrom, Berwickshire, March 31, 1932.

ANGSTRÖM, Anders Jonas (1814-1874) born at Lögddö, Medelpad, (Sweden), August 13, 1814, and educated at Upsala University, became Director of Upsala Observatory in 1843. One of the pioneers of astrophysics, he published in 1862 a list of elements in the Sun. In 1868 he completed the first authoritative map of the solar spectrum. He died on June 21, 1874.

ANTONIADI, Eugene Michael (1870- ) born at Constantinople, (Turkey) March 10, 1870, was assistant to Flammarion at Juvisy Observatory from 1893 to 1902, and became in 1909 assistant at Meudon. He has specialised in the study of the planets. He has studied Mars at many oppositions and in 1924 and 1933 detected clouds at great heights in the Martian atmosphere. In 1935 he concluded, contrary to received opinions, that a thin atmosphere envelops Mercury.

APIAN, Peter Bienewitz (1495-1552) born at Lersnig, (Germany), became Professor of Mathematics at Ingolstadt. His observations on comets from 1531 to 1539 led to the discovery that the tails of comets point away from the Sun. He died in 1552.

ARAGO, François Jean Dominique (1786-1853) was born near Perpignan, (France), February 26, 1786, and educated at Toulouse and Paris. He joined the staff of the Paris Observatory and became Director in



1830. Among his important observations were those of the total solar eclipse of 1842, of which he wrote an exhaustive account. He was one of the first astronomers to maintain that the Sun is wholly gaseous. He died in Paris October 2, 1853.

ARGELANDER, Friedrich Wilhelm August (1799-1875) was born at Memel, (Germany), March 22, 1799, and educated at Königsberg University, where he came under the influence of Bessel. In 1820 he was appointed assistant at Königsberg Observatory, and in 1823 Director of the Observatory at Abo, in Finland. While at Abo, he made his famous determination of the direction and speed of the solar motion, confirming the conclusion reached by W. Herschel in 1783, but at the time generally rejected. In 1836 he was appointed Professor of Astronomy at the University of Bonn and Director of the new Observatory there. Soon after his appointment he drew up his New Uranometry, a determination of the relative magnitudes of all stars visible to the naked eye. In 1852 he commenced work on the Bonn Durchmusterung, a census of the sky giving the positions and magnitudes of all stars down to the ninth magnitude, to the number of 324,198. In this work he was assisted for a time by Schönfeld. This standard work, with accompanying star-chart, was published in 1863. He died at Bonn, February 17, 1875.

AUWERS, Georg Friedrich Julius Arthur (1838-1915) was born at Göttingen, (Germany), September 12, 1838, and educated at Göttingen University. In 1859 he was appointed assistant at Königsberg, where he measured the parallaxes of several stars and discovered the temporary star Nova Scorpii (1860). In 1866 he removed to Berlin and devoted his attention to fundamental astronomy, in which department he gained a world-wide reputation. He reduced the observations of T. Mayer, and carried through a new reduction of Bradley's observations. Along with Gill he determined the Sun's distance by means of some of the smaller asteroids. He died in Berlin on January 24, 1915.

AZOUT, Adrien (1622-1691) born at Rouen, (France), was one of the founders of the Academy of Sciences in Paris and was instrumental in persuading Louis XIV to establish the Paris Observatory. He was employed there, and, independently of Gascoigne, invented the micrometer. He died in 1691.

BAADE, Wilhelm Heinrich Walter (1893- ) born at Scroettinghausen, (Germany), March 24, 1893, educated at Münster and Göttingen, was assistant at Hamburg Observatory from 1919 to 1931. In 1920 he discovered the asteroid Hidalgo whose aphelion distance equals the mean distance of Saturn and whose orbit resembles that of a comet. He went to America in 1931 to join the staff of Mount Wilson



Observatory. He has made a special study of "super-novae", temporary stars of unusual luminosity. He discovered one of these (mag. 17:5) in 1936, and 3 others, one of mag. 9, in 1937.

BABINET, Jacques (1794-1872) born at Lusignan, (France), March 5, 1794, and educated in Paris, was Professor successively at Poitiers and at the College de France. He computed cometary orbits, and in 1861 advanced serious objections to Laplace's nebular hypothesis. He died in Paris, October 19, 1872.

BACKHOUSE, Thomas William (1842-1920) born at Sunderland, (England), on August 14, 1842, and educated at London University, retired from business in early life to devote himself to astronomy. In 1911 he published a catalogue of 9842 stars visible to the naked eye, constructed in collaboration with Peck. He died March 13, 1920.

BACKLUND, Johann Oskar (1846-1916) born at Langhem, Wermland, (Sweden), April 28, 1846, became assistant at Stockholm Observatory in 1873. He was appointed in 1879 assistant at Pulkova Observatory, Russia, and in 1895 Director. His most important work was in the computation of planetary and cometary orbits, and his memoir on Encke's comet was a classic. He died August 29, 1916.

BAILEY, Solon Irving (1854-1931) born at Lisbon, New Hampshire, (U.S.A.), December 29, 1854, was educated in Boston, and after several years spent in teaching, joined the staff of Harvard College Observatory in 1879. He was for many years in charge of the Harvard southern station at Arequipa, Peru. His studies of globular star-clusters resulted in the discovery of "cluster variables". He retired in 1925 and died at Boston, June 5, 1931.

BAILLAUD, Edouard Benjamin (1848-1934) born at Chalon-sur-Saône, (France), February 14, 1848, and educated at Paris, joined the staff of the Paris Observatory. He directed the Toulouse Observatory from 1878 to 1907, when he returned to Paris as Director. He made measures of double stars and of the satellites of Saturn, but devoted most of his attention to the reduction and discussion of observations. He retired in 1926, and died at Toulouse, July 8, 1934.

BAILLY, Jean Sylvan (1736-1793) born in Paris, (France), September 15, 1793, became well-known in his earlier years for his work on comets and star-places and numerous important books, notably a History of Astronomy. He played a prominent part in the French Revolution on the popular side, and became Mayor of Paris, but was charged with conspiracy and guillotined, November 21, 1793.

BAILY, Francis (1774-1844) born at Newbury in Berkshire, (England), April 28, 1774, was a stockbroker by profession, but from early years pursued the study of astronomy. He equipped a small



observatory in 1825 and revised the star-catalogues of earlier astronomers. In 1836, during the annular eclipse of the Sun, he detected the phenomenon known as "Baily's Beads". He died August 30, 1844.

BAKER, Edwin Arthur (1891- ) born at Beaconsfield, Bucks, (England), February 6, 1891, and educated at Reading, became in 1914 assistant at the Royal Observatory, Edinburgh. He co-operated with R.A. Sampson in spectrophotometric work on the intensity of stellar radiation and the effective temperatures of the stars.

BAKHUYZEN, Hendrik Gerard van de Sande (1838-1923) born at the Hague, (Holland), April 2, 1838, studied astronomy at Leyden and became Professor at Delft in 1867. In 1872 he was appointed Director of Leyden Observatory, which post he held till 1908. Most of his work was in fundamental astronomy. He re-determined the rotation period of Mars with a probable error of one-millionth of its amount. He died at Leyden, January 8, 1923.

BAKHUYZEN, Ernst Frederik van de Sande (1848-1918) brother of above, born at the Hague, (Holland), January 8, 1848, joined the staff of Leyden Observatory in 1870, and succeeded his brother as Director in 1908. He investigated the distribution of the stars, the Moon's orbit and the solar motion. He died March 3, 1918.

BALL, Robert Stawell (1840-1913) born at Dublin, (Ireland), July 1, 1840, was educated at Trinity College, Dublin, and was appointed assistant astronomer to Lord Rosse at Birr Castle, Parsonstown where he observed the great meteoric shower of 1866. In 1874 he was appointed Professor of Astronomy at Dublin and Royal Astronomer of Ireland. At Dublin he undertook a search for stars of large parallax. Knighted in 1886, he became Professor of Astronomy at Cambridge in 1892. He devoted much attention to problems of planetary evolution. He enjoyed widespread fame as a popular writer and lecturer on astronomy. He died at Cambridge, November 25, 1913.

BARNARD, Edward Emerson (1857-1923) born at Nashville, Tennessee, (U.S.A.), December 16, 1857, the son of a poor widow, was apprenticed at eight years of age to a photographer in his native town. As a small boy he began the study of astronomy and made a reputation for himself at the age of 23 by his discovery of the comet of 1881. After graduating at Vanderbilt University, he was appointed to the Lick Observatory (1888) and to the Yerkes Observatory (1897). He discovered in 1892 the fifth satellite of Jupiter, and commenced at the Lick Observatory his systematic photographic survey of the sky. He discovered the swift-moving star in Ophiuchus known by his name, and in 1919 published a catalogue of the dark nebulae, which he correctly surmised to be clouds of obscuring matter. He died February 4, 1923.



BAUSCHINGER, Julius (1860-1934) was born at Fürth in Franconia, (Germany), January 26, 1860. Educated at Munich and Berlin Universities, he became Professor at Berlin in 1896 and at Strasbourg in 1909. His chief work was mathematical astronomy and the computation of planetary orbits. He was transferred to Leipzig in 1920. He died January 21, 1934.

BAYER, Johann (1572-1625) born at Rhain in Bavaria, (Germany), was a lawyer by profession and an astronomer by choice. His chief work, which entitles him to enduring fame, was his Uranometria, published at Augsburg in 1603, in which he catalogued the positions and magnitudes of 500 stars in addition to 777 which appeared in Tycho Brahe's catalogue. He designated the chief stars of each constellation by the letters of the Greek alphabet. He died in 1625.

BEER, Wilhelm (1797-1850) born in Berlin, (Germany), January 4, 1797, was a banker by profession and an amateur astronomer. He took lessons in astronomy from Mädler, and was closely associated with him in his work on the Moon and Mars. He died March 27, 1850.

BÉLOPOLSKY, Aristarch (1854-1934) born in Moscow, (Russia), July 13, 1854, studied astronomy at Moscow University, and served as assistant in Moscow Observatory from 1878 to 1888 when he was appointed to Pulkova. Here he specialised in spectroscopic astronomy, determining by means of Doppler's principle the rotation period of Saturn's rings and detecting the duplicity of the fainter component of Castor. His study of variable stars was long-continued and fruitful. He became Director of Pulkova Observatory in 1916, but resigned two years later. He died May 16, 1934.

BESSEL, Friedrich Wilhelm (1784-1846) born at Minden on the Weser, (Germany), July 22, 1784, was originally a clerk in a commercial house in Bremen and studied astronomy in his leisure. His re-determination of the orbit of Halley's comet came to the notice of Olbers, through whose influence he was appointed assistant to Schröter at Lilienthal. In 1810 he became Professor of Astronomy at Königsberg and Director of the Observatory there. He carried out the reduction of Bradley's observations (1819) and determined the positions of 75,000 stars. In December 1838 he announced that he had successfully measured the distance of the star 61 Cygni. He detected the irregular motions of the stars Sirius and Procyon and deduced that these were caused by the gravitational pull of invisible satellites, discovered many years later. He died at Königsberg, March 17, 1846.

BIANCHINI, Francisco (1662-1729) born at Verona, (Italy), December 16, 1662, became librarian to Pope Alexander VIII and established an observatory at Albano. He discovered three comets between 1684 and 1723. He was a careful observer of the Moon and first discovered the "great Alpine valley" on its surface. He observed Venus and concluded that its rotation was performed in 24 days. He died March 2, 1729.



BIELA, Wilhelm von (1782-1856) born at Rosslau in the Harz, (Germany), March 19, 1782, served in the Austrian army from 1805. An amateur astronomer, he discovered the famous comet which bears his name while stationed at Josephstadt, in Bohemia, on February 27, 1826. He died at Venice, February 18, 1856.

BIGOURDAN, Guillaume (1851-1932) born at Sistels, (France), April 6, 1851, and educated at Paris, was assistant at Toulouse from 1877 and at Paris from 1879. He determined the precise position of all known nebulae in the northern hemisphere, and discovered many new nebulae. He was Director of the Bureau d'Heure from 1913 to 1928. He died February 28, 1932.

BIRMINGHAM, John (1829-1884) born at Tuam, (Ireland), was an amateur astronomer who discovered the famous "blaze star", Nova Coronae, in 1866, and compiled a standard catalogue of red stars. He died in 1884.

BOBROVNIKOFF, Nicholas Theodor (1896- ) born at Starobielsk, (Russia), April 29, 1896, and educated at Kharkov, went to America and became in 1934 Professor at Wesleyan University, Delaware. A leading authority on comets, he advanced in 1929 a new theory of their origin. He has also investigated the solar prominences.

BODE, Johann Elert (1747-1826) born at Hamburg, (Germany), January 19, 1747, was appointed in 1772 Director of Berlin Observatory. In that year he drew attention to the remarkable numerical relationship between the distances of the planets, known as "Bode's Law." On the strength of this "law" he predicted the existence of a planet between Mars and Jupiter, and in 1800 initiated a search for the missing body which resulted in the discovery of Ceres, the first of the asteroids. He also compiled a star-catalogue. He was a prolific writer and did much to popularise astronomy. He died at Berlin, November 23, 1826.

BOEDDICKER, otto (1853-1937) born at Iserlohn, Westphalia, (Germany) November 19, 1853, and educated at Leipzig, was assistant at Göttingen and Hamburg Observatories, and from 1880 astronomer to Lord Rosse at Birr, Ireland. His exquisite delineation of the Milky Way as seen by the naked eye was published in 1892. He made careful observations of Jupiter and measured lunar radiation. He retired in 1916 and later returned to Germany. He died in Berlin, August 31, 1937.

BOK, Bart Jan (1906- ) born at Hoorn, (Holland), April 28, 1906, was assistant to van Rhijn at Groningen from 1927 to 1929. Emigrating to America in 1929, he became Assistant Professor of Astronomy at Harvard in 1933 and Associate Professor in 1939. He has specialised in the study of stellar distribution, the structure of the galactic system, and the distribution of the galaxies in space, concluding in 1934 that the latter is non-uniform.



BOND, William Cranch (1789-1859) born at Falmouth, Maine, (U.S.A.), September 9, 1789, was in early life a watchmaker. His fame as an amateur astronomer led to his appointment as Director of the new Harvard College Observatory. He discovered in 1848 Saturn's seventh satellite, Hyperion, and, in 1850, Saturn's "dusky" ring. A pioneer of celestial photography, he died in January 1859.

BOND, George Phillips (1825-1865), son of above, was born at Dorchester, Massachusetts, (U.S.A.), May 20, 1825. Educated at Harvard, he succeeded his father as Director of Harvard Observatory in 1859. He studied Donati's comet, double stars, and nebulae. He was the first astronomer to photograph a comet. He died February 17, 1865.

BOSS, Lewis (1846-1912) was born at Providence, Rhode Island (U.S.A.), October 26, 1846. Educated at Dartmouth College, he was appointed to Washington Observatory in 1872, and to Dudley Observatory, Albany, New York, as Director, in 1876. He specialised in practical astronomy, more particularly the proper motions of the stars. His chief discovery was that of the "moving cluster" in Taurus. He died October 5, 1912.

BOUVARD, Alexis (1767-1843) born at Chamonix, (France), June 27, 1767, was a shepherd boy in his youth. Making his way to Paris, he became a teacher of mathematics and latterly assistant to Laplace. He discovered several comets, investigated the lunar theory, and drew attention to the irregularities in the motion of Uranus. He died June 7, 1843.

BRADLEY, James (1693-1762) born at Sherborne, Gloucestershire, (England), was educated at Northleach and at Balliol College, Oxford. He entered the ministry of the Anglican Church and was appointed Vicar of Bridstow in Monmouthshire in 1719. He became Professor of Astronomy at Oxford in 1721 and Astronomer-Royal of England in 1742. His most famous discoveries were those of the aberration of light and the nutation of the Earth's axis; but the work which ensures his title to lasting fame was his accurate determination of the positions of 60,000 stars, carried through at Greenwich from 1750 to 1762 - the basis of modern statistical astronomy. He died July 13, 1762.

BRAHE, Tycho (1546-1601) born at Knudstrup, Scania, (then part of Denmark), December 14, 1546, the son of a nobleman, was educated at Copenhagen and Leipzig Universities. When a boy of 14, his interest in astronomy was awakened by an eclipse of the Sun and he abandoned the political career which his father had planned for him in order to devote himself to astronomy. In 1572 he was the chief observer of the famous temporary star, Nova Cassiopeiae, the brightest ever observed. His work on the nova brought him fame and the King of Denmark presented him with the island of Hveen



in the Sound. Here he built an observatory (Uraniberg) where he worked till 1596. He made a vast number of observations on star positions and on the planet Mars which formed the basis of Kepler's theoretical work. He proved that the comet of 1577, and presumably all comets, was far beyond the Moon. Abandoning the old Ptolemaic theory, and unable to accept the Copernican because of religious scruples, he put forward as a compromise the "Tychonic System" which however, found few supporters. Owing to a quarrel with the Danish government he went into exile. Appointed to the office of Imperial Mathematician to the Emperor Rudolf II, he settled in Prague, where he died October 24, 1601.

BRÉDIKHINE, Theodor Alexandrovitch (1831-1904) born at Nikolaieff, (Russia), December 8, 1831, was educated at Odessa and Moscow, and appointed to the staff of Moscow Observatory of which he became Director in 1865. His most important work was on the tails of comets, which he divided into three types, and which he ascribed to a repulsive force resident in the Sun; he also studied meteors and meteor streams. He was appointed in 1890 Director of Pulkova Observatory, but retired in 1894. He died May 14, 1904.

BRORSEN, Theodor (1819-1895) born at Norburg, (Denmark), became assistant at Hamburg Observatory. He discovered several comets and, in 1854, the "Gegenschein" or counter-glow. He died in 1895.

BROWN, Ernest William (1866-1938) born at Hull, (England), November 29, 1866, went to America after taking his degree at Cambridge and was Professor of Mathematics successively at Haverford and Yale. His chief work was on the lunar theory; he compiled standard Tables of the Moon's motion. He died July 22, 1938.

BRÜNNOW, Franz Friedrich Ernst (1821-1891) was born at Berlin, (Germany), November 18, 1821, and educated at Berlin University. He was successively Director of Bilk Observatory near Dusseldorf (1851), and Breslau Observatory (1854). He went to America in 1854 as Director of Ann Arbor Observatory, Michigan, but returned to Europe in 1863 as Royal Astronomer of Ireland. He measured the parallaxes of several stars, among them the swift-moving star "Groombridge 1830". He left Dublin in 1874 and returned to Germany. He died at Heidelberg, August 29, 1891.

BURNHAM, Sherburne Wesley (1838-1921) born at Thetford, Vermont, (U.S.A.), December 12, 1838, was trained as a law reporter, and followed his profession for many years. Settling near Chicago, he devoted his spare time to astronomy. He acquired a small telescope, and began to make careful measures of double stars and to search for new pairs. His fame as observer and discoverer led



to his appointment to the staff of the Lick Observatory (1888-1892) and to the Yerkes Observatory in 1897. He also held a professorship of astronomy in Chicago University. He discovered over 1300 new pairs. His General Catalogue of Double Stars is a standard reference work. He died March 11, 1921.

CACCIATORE, Gaetano (1814-1889) was born at Palermo, Sicily, (Italy), March 14, 1814. Educated at Palermo, he joined the staff of the Observatory, of which his father was Director. His chief work was in spectroscopic astronomy; he observed eclipses and investigated the Zodiacial Light. He succeeded his father as Director, and died June 16, 1889.

CALLANDREAU, Jean Pierre Octave (1852-1904) born at Angouleme, (France), September 18, 1852, joined the staff of the Paris Observatory in 1874. An authority on comets, he developed the "capture theory" of their origin. He died February 13, 1904.

CAMPBELL, William Wallace (1862-1938) born in Hancock County, Ohio, (U.S.A.), April 11, 1862, was educated at Michigan University, and became lecturer on astronomy there in 1888. He joined the staff of the Lick Observatory, California, in 1891. He was one of the outstanding spectroscopic astronomers of his time. He determined the solar motion from the radial motions of stars, and discovered 339 spectroscopic binaries, among them, in 1899, the Pole Star, and in 1900, Capella. He determined the radial velocities of hundreds of stars and of 125 nebulae, and in 1910 discovered the increase of radial velocity with advancing spectral type, independently of Kapteyn. Appointed Director of the Lick Observatory in 1900, he retired in 1930 and died at San Francisco, June 14, 1938.

CANNON Annie Jump (1863- ) born at Dover, Delaware, (U.S.A.), December 11, 1863, and educated at Wellesley College, became assistant at Harvard College Observatory in 1897 and curator of astronomical photographs in 1911. Her chief work has been the classification of stellar spectra.

CARRINGTON, Richard Christopher (1826-1875) born at Chelsea, London, (England), May 26, 1826, and educated at Cambridge, built and equipped a private observatory at Redhill in Surrey. He carried through a survey of the circumpolar stars, but his chief work was on the Sun. He detected, independently of Spörer, the Sun's equatorial acceleration, and also the law of sun-spot zones. His health broke down in 1865, and he died at Churt, in Surrey, November 27, 1875.

CASSINI, Giovanni Domenico (1625-1712) born at Perinaldo, (Italy), June 8, 1625, studied astronomy at Genoa, and became in 1650



Professor at Bologna. His earlier work was the telescopic observation of the planets. He determined the rotation periods of Mars and Jupiter, and constructed tables of the motions of Jupiter's satellites. In 1669 he was invited to Paris to become head of the new Observatory there. He discovered four satellites of Saturn-Japetus (1671), Rhea (1672), Tethys and Dione (1684), and also the division of Saturn's ring into an outer and inner ring. From his measures of the solar parallax, he computed the Sun's distance at 86 million miles - a remarkable approximation to the truth at that stage in astronomy. He died in Paris, September 14, 1712.

CASSINI, Jacques (1677-1756) son of above, born in Paris, (France), on February 18, 1677, became assistant to his father, whom he succeeded as Director of the Paris Observatory. He attempted to measure the diameter of Sirius, and confirmed Halley's discovery of the proper motion of certain stars. He died April 11, 1756.

CELORIA, Giovanni (1842-1920) born at Casale Monferrato, near Alessandria, Piedmont, (Italy), January 29, 1842, graduated at Turin University in 1863, and after studying astronomy in Germany, was appointed assistant to Schiaparelli at the Brera Observatory, Milan. He became chief assistant in 1873. He computed the orbits of many binary stars, compiled a star-catalogue and carried through an important series of star-gauges, in the course of which he penetrated to the boundary of the galactic system. He succeeded Schiaparelli in 1900, retired in 1917, and died in Milan, August 18, 1920.

CERULLI, Vincenzo (1859-1927) born at Teramo, (Italy), April 20, 1859, established towards the end of the nineteenth century a private observatory in his native town. Here he studied the planets, especially Venus and Mars. He confirmed Schiaparelli's rotation period for Venus and put forward the famous "optical illusion" theory of the canals of Mars. He became honorary Professor of Astronomy in the University of Rome, and died at Merate, near Milan, May 30, 1927.

CHACORNAC, Jean (1823-1873) born at Lyons, (France), spent most of his life at the Paris Observatory. He detected six asteroids between 1853 and 1862, and also discovered the variability of a nebula in Taurus. He undertook the construction of an "ecliptic chart" to facilitate the discovery of asteroids, but died in 1873 before its completion.

CHALLIS, James (1803-1882) born at Braintree, Essex, (England), December 12, 1803, was educated at Cambridge and ordained a clergyman of the Church of England in 1830. He was Professor of Astronomy at Cambridge from 1836 to his death, and Director of



the Observatory until 1861. He observed the duplication of Biela's comet in 1846, in which year he searched unsuccessfully for Neptune. He died December 3, 1882.

CHANDLER, Seth Carlo (1846-1913) born at Boston, Massachusetts, (U.S.A.), September 17, 1846, was by profession an actuary, who took up astronomy as a recreation about 1881. He investigated the variation of latitude (1884-1885) and published three catalogues of variable stars, on which he was a recognised authority. He died December 31, 1913.

CHARLIER, Carl Vilhelm Ludwig (1862-1934) born at Östersund, (Sweden), April 1, 1862, was educated at Upsala University. He was chief assistant at Upsala Observatory from 1890 to 1897, when he was appointed Professor of Astronomy at Lund. He was one of the greatest cosmologists of the day. His study of "the Galaxy of the B-type stars" (1916-1917) resulted in the discovery that these form a "local cluster" within the greater galaxy. He retired in 1927 and died at Lund on November 5, 1934.

CHARLOIS, Auguste (1864-1910) born at Nice, (France), joined the staff of Mont Gros Observatory, near Nice in 1881. He was a noted asteroid-hunter and detected over a hundred. He was assassinated, March 26, 1910.

CHLADNI, Ernst Florens Friedrich (1756-1827) born at Wittenberg, (Germany), November 30, 1756, was the first to prove (1794) the extra-terrestrial origin of meteoric stones. He died at Breslau, April 3, 1827.

CHRISTIE, William Henry Mahoney (1845-1922) born at Woolwich, (England), October 1, 1845, and educated at Cambridge, became chief assistant at Greenwich in 1870 and Astronomer-Royal in 1881. He reorganised and modernised the Observatory and founded the Observatory magazine. Knighted in 1904, he retired in 1910 and died January 22, 1922.

CLAIRAUT, Alexis Claude (1713-1765) born at Paris, (France), May 7, 1713, was a precocious boy, who studied the higher mathematics at the age of 11 and sent a mathematical paper to the Academy of Sciences when he was 13. He became one of the most distinguished mathematicians of his time; he investigated the Moon's motion and the orbit of Halley's comet, whose return in 1758 he predicted to within a month. He died May 17, 1765.

CLERKE, Agnes Mary (1842-1907) born at Skibbereen, County Cork, (Ireland), February 10, 1842, formed as a girl of 15 the project of writing a history of astronomy which occupied her for nearly thirty years. Resident in London from 1877, she completed her monumental History of Astronomy during the Nineteenth Century in 1885. It went through four editions and is a standard source-book. She wrote several other important books on astronomy, historical and biographical. She died in London, January 20, 1907.



COBLENTZ, William Webber (1873- ) born at North Lima, Ohio, (U.S.A.), November 20, 1873, was educated at Cornell University. He became Physicist at the Bureau of Standards (U.S.A.) in 1905. In 1924-1925 and 1926-1927 he worked at the Lowell Observatory and co-operated with Lampland in measuring the temperature of Mars.

COGGIA, Jerome (1849-1919) born at Ajaccio, Corsica, (France), February 23, 1849, joined the staff of the Marseilles Observatory in 1866, discovered numerous asteroids and comets, of which the bright comet of 1874 bears his name. He retired in 1917 and died January 15, 1919.

COMMON, Andrew Ainslie, (1841-1903) born of Scottish extraction at Newcastle-on-Tyne, (England), August 7, 1841, was by profession an engineer, who devoted his spare time to astronomy. He was a pioneer of astronomical photography and secured important photographs of the Orion nebula in 1882 and 1883. He died suddenly, June 2, 1903.

COPELAND, Ralph (1837-1905) born at Woodplumpton, Lancashire, (England), September 3, 1837, spent some years in Australia as a boy, studied astronomy in Germany and became assistant in Göttingen Observatory. He held posts at Parsonstown, Ireland (1871-1874), Dublin Observatory (1874-1876), and Dunecdt Observatory, Scotland, (1876-1889). In 1889 he was appointed Astronomer-Royal for Scotland and Professor of Astronomy in Edinburgh University. He specialised in spectroscopic astronomy and made important observations of the spectra of comets and Wolf-Rayet stars. He died in Edinburgh, October 27, 1905.

COPERNICUS, Nicolaus (1473-1543) the Latinised name of Niklas Kopernigk, born at Thorn, on the Vistula, (Prussian Poland), February 19, 1473, by common consent the founder of modern astronomy. He was educated at Cracow and Bologna, followed an ecclesiastical career, and was appointed Canon of Frauenberg in Ermland in 1501. In the same year he went to Padua in Italy to study law and medicine and returned to Frauenberg in 1506. He discharged his ecclesiastical duties faithfully and also practised medicine, but his main interests were scientific. Early in life he was led to doubt the geocentric (Ptolemaic) system of the world and for thirty years he was engaged in working out the heliocentric system, since known as the Copernican. By 1533 he had completed his great book, De Revolutionibus Orbium Coelestium but fearing a hostile reception, he delayed publication. Yielding to the entreaties of his friend Rheticus, he agreed, in 1542, to its publication and an advance copy reached him on his death-bed, May 24, 1543. The book was condemned as heretical and placed by the papal authorities on the Index of prohibited works in 1616.



CORNU, Alfred (1841-1902) born at Chateauneuf, near Orleans, (France), March 6, 1841, and educated at Orleans and Paris, became professor at the Ecole Polytechnique in 1867. He re-determined the velocity of light in 1874, and made an exhaustive investigation of the solar spectrum. He died suddenly near Orleans, April 12, 1902.

CORTIE, Aloysius Laurence (1859-1925) born in London, (England), April 22, 1859, was educated at Stonyhurst College and entered the Jesuit Order. He joined the teaching staff at Stonyhurst in 1885, and was from 1919 Director of the Observatory. A specialist in spectroscopic astronomy, he observed several eclipses, and investigated sun-spots and their relation to terrestrial magnetism. He died May 16, 1925.

COWELL, Philip Herbert (1870- ) born at Calcutta, (India), of English parentage, August 7, 1870, and educated at Cambridge, was chief assistant at Greenwich Observatory from 1896 to 1910 and Superintendent of the Nautical Almanac from 1910 to 1930. His most outstanding piece of work, in conjunction with Crommelin, was on Halley's comet; they investigated all the returns of the comet since 240 B.C. and their prediction of the perihelion passage in 1910 was only three days in error. He has also investigated ancient eclipses and the retardation of the Earth's rotation.

CROMMELIN, Andrew Claude de la Cherois (1865-1939) born of French extraction at Cushendun, Antrim, (Ireland), February 6, 1865, was educated at Cambridge, and in 1891 joined the staff of Greenwich Observatory. He became famous through his computation, in conjunction with Cowell of the return of Halley's comet in 1910. He was a recognised authority on the orbits of asteroids and comets. He retired in 1927 and died September 20, 1939.

CURTIS, Heber Doust (1872- ) born at Maskegon, Michigan, (U.S.A.), June 27, 1872, and educated at Michigan University, became assistant at the Lick Observatory in 1904. From 1920 to 1930 he was Director at Alleghany Observatory. His researches have been chiefly devoted to nebulae. He has investigated the distances and motions of the planetary nebulae and the status of the so-called spirals.

CYSAT, Jean Baptiste (1588-1657) born at Lucerne, (Switzerland), entered the Jesuit Order and became Professor of Mathematics at Ingolstadt. A pioneer of telescopic astronomy, he made the first recorded observation of the Orion nebula in 1618. He died on March 3, 1657.



D'ALEMBERT, Jean le Rond (1717-1783) born in Paris, (France), November 16, 1717, was educated in Paris, and devoted his life to mathematical astronomy. His important researches included the problem of three bodies, precession and nutation. He died in Paris on October 29, 1783.

DAMOISEAU, Charles Theodore (1768-1846) born at Besançon, (France), served in the army, and became director of the Military School in Paris. He is chiefly remembered for his work on the Moon's motion; he also investigated the orbits of Halley's and Biela's comets. He died April 6, 1846.

D'ARREST, Heinrich Ludwig (1822-1875) born of French extraction in Berlin, (Germany), August 12, 1822, studied at Berlin University and discovered a comet (D'Arrest's comet) in 1844. Assistant to Encke in Berlin (1844-1848), he co-operated with Galle in the search for Neptune which led to that planet's discovery in 1846. In 1848 he was transferred to Leipzig, and in 1857 to Copenhagen. He discovered one asteroid (Freia) in 1862 and several comets and fixed the positions of many of the nebulæ. Latterly he devoted attention to spectroscopic astronomy and investigated the red stars. He died in Copenhagen, June 14, 1875.

DARWIN, George Howard (1845-1912), son of the famous biologist, Charles Darwin, was born at Downe, Kent, (England), July 9, 1845, and educated at Cambridge. He became Professor of Astronomy there in 1883. He began in 1879 his long-continued work on the tides, and in his monumental work, The Tides and Kindred Phenomena in the Solar System (1898) he outlined his celebrated theory of the tidal origin of the Moon. Knighted in 1906, he died December 7, 1912.

DAWES, William Rutter (1799-1868) born in London, (England), March 19, 1799, was educated for the ministry, and became minister of the Congregational Church at Ormskirk, Lancashire. Here he erected a small observatory. In 1839 he resigned his charge in order to devote himself wholly to astronomy, and removed to London. One of the greatest observers of his day, he was known as "eagle-eyed Dawes". He specialised in double stars, observed the Sun persistently, discovered the "dusky ring" of Saturn in 1859, independently of W.C. Bond, and was one of the most careful students of Mars. He died February 15, 1868.

DEE, John (1527-1608), one of the earliest English astronomers, entered Cambridge University in 1542. At Mortlake, near London, he established a library and collection of astronomical instruments. He carefully studied the new star of 1572. Among his pupils and disciples was Thomas Digges. He died in 1608.



DELAMBRE, Jean Baptiste Joseph (1749-1822) born at Amiens, (France), September 19, 1749, and educated in Paris, became Professor in the College de France. He is famous chiefly as an astronomical historian. His History of Astronomy in five volumes is recognised as a standard work. He died August 19, 1822.

DE LA RUE, Warren (1815-1889) born in Guernsey, (Channel Islands), January 18, 1815, went to England in his youth and amassed a considerable fortune as a papermaker. He became one of the best-known amateur astronomers of his day, and was one of the pioneers of astronomical photography. In 1853 he secured the first photographs of the Moon and, during the total eclipse of 1860, he photographed the solar prominences. He died in London on April 19, 1889.

DELAUNAY, Charles Eugene (1816-1872) born at Lusigny, (France), April 9, 1816, and educated at Troyes and Paris, became at an early age a professor in the Ecole des Mines. He devoted himself to mathematical astronomy, investigating the tides, the precession of the equinoxes, and the Moon's motion. He became a leading authority on the latter subject, which occupied him for 20 years. Appointed Director of the Paris Observatory in 1870, he was accidentally drowned by the capsizing of a pleasure-boat at Cherbourg, August 5, 1872.

DELISIE, Joseph Nicolas (1688-1768) born in Paris, (France), April 4, 1688, was attracted to astronomy by the eclipse of 1706. He spent 22 years in Russia as "Court Astronomer" and returned to Paris to a professorship in 1747. He investigated sun-spots, and proposed a method of determining the solar parallax by means of the transits of Venus and Mercury. He died September 12, 1768.

DELPORTE, Eugene Joseph (1882- ) born at Gemappes, Brabant, (Belgium), January 10, 1882, and educated at Brussels University, joined the staff of Uccle Observatory, Brussels, in 1903, and became Director in 1936. He discovered numerous asteroids, among them (1932) Amor and (1936) Adonis, which approaches the Earth to within 1,300,000 miles. He completed in 1930 a new delimitation of the constellation boundaries, adopted by the International Astronomical Union.

DEMBOWSKI, Ercole (1812-1881) born at Milan, (Italy), January 12, 1812, established a private observatory at Naples, and later transferred it to Milan. He specialised in the observation of double stars; his careful measures marked an important stage in this branch of astronomy. He died January 19, 1881.

DENNING, William Frederick (1848-1931) born at Redpost, near Radstock, Somerset, (England), November 25, 1848, began his work in astronomy as a boy. By profession an accountant in Bristol,



he held no official scientific post, but became one of the greatest astronomers of his day. His telescopic work on the planets, especially Mercury, Mars, Jupiter and Saturn, was of permanent value. He re-determined in 1903 the rotation period of Saturn. He discovered several comets, but his chief title to fame is as an observer of meteors; he determined the radiant points of 1179 showers. He died at Bristol, June 9, 1931.

DE SITTER, Willem (1872-1934) born at Sneek, Friesland, (Holland), May 6, 1872, was educated at Arnhem and at Groningen University, where he came under the influence of Kapteyn. He was assistant at the Cape Observatory, South Africa, from 1897 to 1899, and was assistant to Kapteyn from 1900 to 1908, when he became Professor of Astronomy at Leyden. In 1918 he was appointed Director of the Observatory there. His first important investigation was on the satellites of Jupiter. Later researches included the Earth's rotation, the astronomical consequences of the theory of relativity, and the extent and origin of the Universe. The "de Sitter Universe", finite yet unbounded, was calculated to be 2000 million light-years in radius, containing 80,000 million galaxies. His book Kosmos (1932) embodies much of his thought. He died at Leyden, November 19, 1934.

DESLANDRES, Henri Alexandre (1853- ) born in Paris, (France), July 24, 1853, and educated at the Ecole Polytechnique, became assistant to Janssen at Meudon, and at an early age, earned a world-wide reputation as an authority on the Sun. Independently of Hale, he invented (1891) the spectroheliograph, and later the "velocity-recorder". In 1908 he was appointed Director of the Meudon Observatory.

DICK, Thomas (1772-1857) born at Dundee, (Scotland), November 24, 1772, was educated at Edinburgh University and qualified for the ministry but turned to teaching instead. He became schoolmaster at Methven, in Perthshire, where he set up an observatory, and made observations on the planets, especially Venus. He became famous as a writer on astronomy, and his books enjoyed an international reputation. He played an important part in the reconciliation of science and religion. In 1827 he removed his observatory to Broughty-Ferry, where he died July 29, 1857.

DIGGES, Leonard (16th cent.) born in Kent, (England), one of the first of English astronomers, experimented with "optic tubes" and wrote a Prognosticator Everlasting, a compilation of astronomical knowledge, weather-lore and astrology. He died in 1559.

DIGGES, Thomas (1546-1595) one of the earliest English astronomers, son of the above, became, after his father's death, the pupil and ward of John Dee. He observed the bright "nova" of 1572 with great care. He was an early protagonist of the Copernican system.



DI VICO, Francisco (1805-1848) born at Ancona, (Italy), May 19, 1805, became Director of the Observatory of the Collegio Romano. He specialised in observing the planets, particularly Venus, and discovered in 1844 the comet which bears his name. He died November 5, 1848.

DCIG, Peter (1882- ) born in Glasgow, (Scotland), January 26, 1882, became a ship draughtsman, and later, General Secretary of the Engineering and Shipbuilding Draughtsmen's Union. His researches on the distances and distribution of open clusters in 1925 were confirmatory of the existence of a "local cluster". He has also investigated the spectral characteristics of binary stars and globular clusters.

DONATI, Giovanni Battista (1826-1873) was born at Pisa, (Italy), October 16, 1826. At the end of his university career, he was appointed assistant at Florence Observatory, of which he became Director in 1859. He became suddenly famous by his discovery, June 2, 1858, of the most brilliant comet of the century (Donati's comet) which he carefully studied. He was the first to apply the spectroscope to the stars, and made the earliest survey of stellar spectra. His observations of Tempel's comet (1864) demonstrated the gaseous and self-luminous nature of these bodies. He died at the new Observatory at Arcetri, September 20, 1873.

DONNER, Anders Severin (1854-1938) born at Helsingfors, (Finland), November 5, 1854, was educated at Helsingfors, Leipzig, Königsberg, and Berlin. He became assistant at Helsingfors Observatory in 1881, and Director in 1883. He took a large share in the preparation of the Astrographic Chart. He died April 15, 1938.

DOPPELMAYER, Johann Gabriel (1671-1750) born at Nuremberg, (Germany), was for nearly fifty years Professor of Mathematics there. He compiled a star-atlas, and published a chart and description of lunar markings. He died December 1, 1750.

DOPPLER, Christian (1803-1853) born at Salzburg, (Austria), on November 29, 1803, and educated at Vienna, held professorships at Munich and Prague. In 1842 he enunciated the principle, known as "Doppler's principle" that the colour of a luminous body is slightly altered by motions of approach or recession. This principle is the basis of the measurement of radial velocities. He died March 17, 1853.

DÖRFFEL, Georg Samuel (1643-1688) born at Plauen, (Germany), October 11, 1643, and educated at Leipzig for the Lutheran ministry, followed astronomy in his leisure. He computed the orbit of the comet of 1680, which he proved to be parabolic. He died August 6, 1688.



DOUGLASS, Andrew Ellicott (1867- ) born at Windsor, Vermont, (U.S.A.), on July 5, 1867, acted as assistant at Harvard Observatory from 1889 to 1894, when he joined the staff of the newly-founded Lowell Observatory, and collaborated with Lowell in his earlier work on Mars. In 1894 he discovered "canals" in the so-called "seas", thus finally proving their vegetal character. Later he was appointed to Arizona Normal College, and became Professor in Arizona University and Director of Tucson Observatory in 1918. He also investigated the influence of sun-spots on terrestrial vegetation in past ages.

DRAPER, Henry (1837-1882) born in Prince Edward Co., Virginia, (U.S.A.), on March 7, 1837, studied medicine at New York University, and succeeded his father, J.W. Draper, as Professor there. An astronomer of great ability, he did valuable work in the photography of stellar spectra; he was also the first to photograph the Orion nebula. He died November 20, 1882. His widow established a fund to carry on spectrographic work at Harvard in memory of his work.

DREYER, John Louis Emil (1852-1926) was born at Copenhagen, (Denmark), on February 13, 1852, and educated at Copenhagen University. He went to Ireland in 1874 as astronomer to Lord Rosse at Birr Castle, where he made important observations on clusters and nebulae. He became assistant to Ball at Dublin in 1878, and Director of Armagh Observatory in 1882. In addition to the compilation of the New General Catalogue of clusters and nebulae, he did lasting work as a historian of astronomy. His biography of Tycho Brahe (1890) and his Planetary Systems from Thales to Kepler (1906) are standard works. He also edited the papers of W. Herschel (1912). He retired from Armagh Observatory in 1916, and removed to Oxford, where he died September 14, 1926.

DUNER, Nils Christoffer (1839-1914) born at Billeberga, (Sweden), May 21, 1839, was educated at Lund, where he graduated in 1862. After 24 years' service at Lund Observatory, he was appointed Director of Upsala Observatory. He investigated red stars, and discovered numerous variables. By means of Doppler's principle, he found that the Sun's rotation is protracted to  $38\frac{1}{2}$  days in the polar regions. He also investigated spectroscopic binary stars. He retired from Upsala in 1909, and died at Stockholm, November 10, 1914.

DUNHAM, Theodore (1897- ) born in New York, (U.S.A.), December 17, 1897, and educated at Harvard and Princeton, joined the staff of Mount Wilson Observatory in 1929. His spectroscopic work on Jupiter confirmed the presence of ammonia and methane in the Jovian atmosphere. In 1932 he detected carbon dioxide in the atmosphere of Venus.



DYSON, Frank Watson (1868-1939) born at Ashby, Lincolnshire, (England), January 8, 1868, and educated at Bradford and Cambridge University, was chief assistant at Greenwich (1894-1905) and Astronomer-Royal for Scotland (1905-1910). He returned to Greenwich as Astronomer-Royal for England in 1910. His first important work was on stellar motions; he confirmed in 1908 Kapteyn's discovery of the two star-streams. He observed many eclipses, and took a leading part in international co-operative work in astronomy. He retired in 1933 and died at sea on a return voyage from Australia, May 23, 1939.

EASTON, Cornelis (1864-1929) born at Dordrecht, (Holland), September 10, 1864, was trained as a journalist and was editor of several prominent Dutch newspapers and magazines. An amateur astronomer, he completed in 1893 his famous naked-eye delineation of the Milky Way, and in 1903 his measurement of galactic luminosity. He was the first astronomer to suggest that the galactic system is spiral in form, and, in 1908, to emphasise the non-central position of the Sun. He died June 3, 1929.

EDDINGTON, Arthur Stanley (1882- ) born at Kendal, Westmorland, (England), December 28, 1882, was educated at the Quaker school in Kendal, and at Manchester and Cambridge Universities. Appointed in 1906 chief assistant at Greenwich Observatory, he confirmed in the same year Kapteyn's discovery of the two star-streams. He also took part in the discovery of the moving clusters. In 1913 he was appointed Professor of Astronomy at Cambridge and Director of the Observatory. His studies of the internal constitution of the stars broke new ground in astronomy, and showed the stars to be much older than hitherto supposed. He devoted much attention to the relativity theory; he led the expedition to west Africa to observe the eclipse of 1919, and successfully measured the displacement of star-images near the eclipsed Sun as predicted by the theory. He was knighted in 1930.

EINSTEIN, Albert (1879- ) born of a Jewish family at Ulm, Württemberg, (Germany), March 14, 1879, and educated at Munich and Zurich, was employed in the Swiss Patent Office in Zurich from 1902 to 1909. In 1905 he enunciated the "special theory of relativity". In 1909 he became Professor at Zurich and in 1911 at Prague. He returned to Zurich in 1912, and settled in Berlin in 1914. From 1915 to 1917 he developed the "general theory of relativity" with its important astronomical consequences. He was exiled from Germany in 1933 on account of his Jewish origin and political sympathies and settled in the United States.

ELGER, Thomas Gwyn (1838-1897) born at Bedford, (England), was trained as a civil engineer and followed that profession, but



retired early to devote himself to astronomy. He observed the planets and stars at his private observatory, but latterly concentrated on the Moon, on which he became the chief English authority. He published in 1895 a fine map of the Moon, with an authoritative descriptive handbook. He died at Bedford, January 9, 1897.

ELKIN, William Lewis (1855-1933) born at New Orleans, (U.S.A.), April 29, 1855, and educated at various German Universities, observed at the Cape in 1881 and 1882, and was appointed Director of Yale Observatory, U.S.A. in 1884. He determined many stellar parallaxes with great accuracy. His health broke down prematurely in 1910 and he retired. After many years of illness, he died May 29, 1933.

EMANUELLI, Pio (1888- ) born in Rome, (Italy), November 3, 1888, became in 1907 assistant and in 1910 observer at the Vatican Observatory. He has specialised in the history of astronomy. He published in 1929 his tables of galactic co-ordinates, and in 1934 his photographic celestial atlas.

ENCKE, Johann Franz (1791-1865) was born at Hamburg, (Germany), a Lutheran minister's son, September 23, 1791. One of a large family, he was left early an orphan, and had a severe struggle with poverty in his youth. In 1811 he entered Göttingen University, and in 1817 he became assistant and in 1822 Director of Seeberg Observatory, near Gotha. He became famous by his computation of the orbit of a faint comet discovered in 1818; he found that it revolved round the Sun in 3½ years, and predicted its return in 1822, which prediction was verified. The comet, the second proved to be periodic, bears his name. He reduced the observations of the transits of Venus in 1761 and 1769, and computed the Sun's distance at 95 millions of miles, which was, up to that date the most accurate determination which had been made. In 1825 he was appointed Director of Berlin Observatory. Here he supervised the construction of charts of the Zodiacal constellations, with a view to distinguishing undiscovered planets from stars; by means of these, his assistants Galle and D'Arrest found Neptune in the place predicted by Le Verrier, September 23, 1846. He retired in 1864 and died at Spandau, August 26, 1865.

ESPIN, Thomas Henry Espinall Compton (1858-1934) born at Birmingham, (England), May 28, 1858, was educated at Oxford and entered the ministry of the Church of England. In 1888 he became Vicar of Tow Law, Durham County. Astronomy was his life-long pursuit. He discovered 3800 red stars between 1885 and 1889 and compiled several catalogues of these objects. He carried through a spectroscopic survey of red stars, and in 1910 he discovered Nova Lacertae. He died at Tow Law, December 2, 1934.



EULER, Leonhard (1707-1783) was born at Basle, (Switzerland), April 15, 1707. His reputation as a mathematician led to an appointment in Russia, where he remained for 14 years. He settled in Berlin in 1741 and returned to Russia in 1766. His chief researches were on the tides, the problem of three bodies and planetary motions. He became blind in 1766, but continued his astronomical work up to his death on September 18, 1783.

EVERSHED, John (1864- ) was born at Gomshall, Surrey, (England), on February 26, 1864. He went to India in 1906 as assistant Director of Kodaikanal and Madras Observatories, and in 1911 became Director. In 1909 he detected radial motion of the gases in sun-spots, outward in the reversing layer, and inward at higher levels in the chromosphere. In all he enumerated over 70,000 prominences. He was the first to show that the Einstein effect was present in the solar spectrum. He returned to England in 1923 and established a private observatory at Ewhurst in Surrey, where researches have been carried out on the shifts of the solar lines, the Zeeman effect in spots, and the solar rotation at higher levels.

EVERSHED, Mary Acworth Orr or (1867- ) born at Plymouth, (England), January 1, 1867, married the above in 1906, and co-operated with him in his solar work. An authority on astronomical history, she is the author of a standard work on Dante and the Early Astronomers.

FABRICIUS, David (1564-1617) born at Esens in East Friesland, (Holland), studied for the ministry of the Reformed Church and held charges at Resterhave and Osteel. One of the earliest pioneers of modern astronomy the friend of Tycho Brahe and Kepler, he discovered in 1596 the variability of Mira Ceti, the first variable star every detected. He was also one of the earliest telescopic observers. He was assassinated by one of his church members at Osteel, May 6, 1617.

FABRICIUS, Johann (1587-1616) born at Resterhave, (Holland), son of above, studied medicine at Leyden and co-operated with his father in astronomical work. On February 27, 1611, independently of Galileo and Scheiner, he discovered sun-spots. He died before his father, in 1616, at the early age of 29.

FAYE, Hervé (1814-1902) was born in Paris, (France), October 1, 1814, and was in 1836 appointed assistant in the Paris Observatory. In 1843 he discovered and exhaustively studied a comet (Faye's comet) which bears his name. In 1865 he advanced his famous theory of the nature and constitution of the Sun, a considerable advance on previous hypotheses. In 1885 he put forward the "meteoric theory" of planetary evolution. He died July 4, 1902.



FERGUSON, James (1710-1776) born at Core of Mayen, near Rothiemay, Banffshire, (Scotland), April 25, 1710, the son of a farm-labourer, became a shepherd boy at the age of 10. While watching his sheep at night he began to study the stars. At 14 he became shepherd to a farmer who encouraged him to continue his studies, and introduced him to influential people; a local butler taught him mathematics. He made his way to Edinburgh, and later to London and became famous as a maker of astronomical clocks, sundials and orreries as well as an observer. In 1761 he observed the transit of Venus and proved that Venus had no satellite. He was the first popular lecturer on astronomy, and his Astronomy explained upon Sir Isaac Newton's Principles was the most authoritative astronomical work of the time. He was one of the first astronomers to suggest an evolutionary origin of the Solar System. He died in London, November 16, 1776.

FISHER, Willard James (1867-1934) born at Waterford, New York, (U.S.A.), September 29, 1867, and educated at Amherst College, held several lectureships in physics before his appointment as Research Associate at Harvard Observatory in 1922. He did pioneer work in the photography of meteors and collected much valuable data regarding meteorites. Appointed in 1928 Lecturer in Astronomy, he died September 2, 1934.

FIZEAU, Armand Hippolyte Louis (1819-1896) born in Paris, (France), September 23, 1819, co-operated with Foucault in securing the first photograph of the Sun in 1845, and re-determined the velocity of light. In 1848 he developed Doppler's principle, showing that spectral lines shift by reason of approach or recession. He died September 18, 1896.

FLAMMARION, Camille (1842-1925) born at Montigny-le-Roi, Haute Marne, (France), February 25, 1842, studied for the priesthood at Langres, but abandoned theology for astronomy, and in 1858 joined the staff of the Paris Observatory. In 1862 he left the Observatory for the Bureau des Longitudes and became editor of a scientific journal. In 1883 he established a private observatory at Juvisy-sur-Orge. His observations on the Moon afforded him, in 1879, evidence of certain minute changes. His work on Mars was long-continued and exhaustive. He studied double-stars and detected numerous cases of star-drift. He gave much time to the popularisation of astronomy as author and lecturer. He died at Juvisy, June 3, 1925.

FLAMSTEED, John (1646-1719) was born at Denby, near Derby, (England), August 19, 1646. A delicate lad, he began the study of astronomy in childhood, and before he was twenty he constructed a catalogue of seventy stars. He left Cambridge University in 1674, intending to enter the ministry of the Church of England, but his fame as an astronomer led to his appointment in 1675 as the first



Astronomer-Royal of England. At Greenwich he succeeded in determining the position of 3000 stars with greater accuracy than had ever been possible before. His star-atlas, a standard work, was not published till ten years after his death which occurred at Greenwich, December 31, 1719.

FLEMING, Williamina Paton or (1857-1911) born in Dundee, (Scotland), May 15, 1857, emigrated to America shortly after her marriage. In 1881 she joined the staff of the Harvard Observatory and was in charge of the famous Draper Catalogue; she discovered ten novae and 222 variable stars. She died May 21, 1911.

FONTANA, Francisco (1585-1656) born at Naples, (Italy), and educated for the law, was one of the earliest telescopic observers. He detected a "spot" on Mars in 1638. He died in July 1656.

FONTENELLE, Bernard de Bovier de (1657-1757) born at Rouen, (France), February 11, 1657, spent most of his life in Paris as secretary of the Academy of Sciences. He wrote a famous book on the Plurality of Worlds (1686) and did much to popularise astronomy. He died, almost a centenarian, January 9, 1757.

FÖRSTER, Wilhelm Julius (1832-1921) born at Seydel, Silesia, (Germany), December 16, 1832, was educated at Berlin, where he studied under Encke, and later at Bonn, where he worked with Argelander. He became assistant at Berlin Observatory in 1855 and Director in 1865. His chief researches were on the asteroids; he was also a prolific writer. He retired in 1904 and died January 18, 1921.

FOTHERINGHAM, John Knight (1874-1936) born at Tottenham, London, (England), August 14, 1874, and educated at Oxford, was Lecturer in Ancient History at London University from 1904 to 1915. His historical research led him to the study of ancient eclipses, from which he recognised a definite secular acceleration of the Sun and Moon, to be attributed in part to the retardation of the Earth's rotation. Appointed Reader in Ancient Astronomy at Oxford in 1925, he died December 12, 1936.

FOUCAULT, Jean Bernard Leon (1819-1868) born in Paris, (France), September 18, 1819, abandoned medicine for physics and astronomy. With Fizeau, he secured in 1845 the first photograph of the Sun. In 1851 he performed his famous experiment in the Pantheon, proving beyond all doubt the Earth's axial rotation. He died February 11, 1868.

FOWLER, Alfred (1868-1940) born at Wilsden, Yorkshire, (England), March 22, 1868, was assistant to Lockyer at South Kensington and



later became Professor of Astrophysics in London University and Yarrow Research Professor of the Royal Society; he retired in 1934. His spectroscopic researches on the Sun, the stars and comets were of high importance. He detected carbon monoxide in comets and titanium oxide in red stars. He died June 24, 1940.

FRACASTORO, Girolamo (1483-1553) born at Verona, (Italy), studied at Padua and was for some time a Professor there. Later he retired to Verona. He attempted to revive the Eudoxian theory of homocentric spheres. Independently of Apian, he observed that comets' tails point away from the Sun. He died in 1553.

FRANKLIN-ADAMS, John (1843-1912) born at Peckham, London, (England), August 5, 1843, was engaged in commerce in early life and did not take up astronomy till he was 47. He undertook a photographic chart of the entire heavens, and went to South Africa to include the southern stars. Despite ill-health he accomplished his task, and the Franklin-Adams charts are regarded as standards of reference. He died August 13, 1912.

FRANZ, Julius Heinrich (1847-1913), born at Rummelsburg, Pomerania, (Germany), June 28, 1847, studied at Berlin, and became assistant at Königsberg Observatory. He was appointed Professor at Breslau in 1897. His chief work was on the Moon, on which he published a standard hand-book in 1906. He died January 28, 1913.

FRAUNHOFER, Joseph von (1787-1826) born at Straubing, Bavaria, (Germany), March 6, 1787, was left an orphan in early childhood, and apprenticed to a looking-glass maker in Munich. Rescued from the wreckage of the collapsed tenement in which he lodged (July 21, 1801) he received from the Elector of Bavaria, who witnessed the accident, a sum of money which enabled him to educate himself. In 1806 he joined the staff of the Physical and Optical Institute of Munich, of which he became Director in 1823. He constructed in 1817 the finest refracting telescope in the world, the first to be moved by clockwork. He also invented the diffraction grating and the objective prism. He detected in 1814 the dark lines in the solar spectrum (the "Fraunhofer lines") which he proved to be solar in origin; he made the first observations of the spectra of the stars. He died at Munich on June 7, 1826.

FREUNDLICH, Erwin Finlay (1885- ) born at Biebrich on the Rhine, (Germany), May 29, 1885, and educated at St. Andrews, Scotland, was assistant at Potsdam Observatory and from 1920 to 1933 was Director of the Einstein Institute at Potsdam. After holding professorships at Istanbul (1933-1937) and Prague (1937-1939) he settled in Scotland as Lecturer in Astronomy at St. Andrews, and Director of the University Observatory. He investigated stellar radial motions and the theory of relativity, and did important work on the constitution of the globular clusters.



FROST, Edwin Brant (1866-1935) born at Battleboro, Vermont, (U.S.A.), July 18, 1866, was educated at Dartmouth and Princeton and later at Berlin where he worked under Vogel. In 1896 he became Professor at Dartmouth and in 1898 joined the staff of the Yerkes Observatory of which he was appointed Director in 1905. His most important work was on the radial motions of the stars; he determined 868 velocities. He retired in 1932 and died May 14, 1935.

FURNESS, Caroline Ellen (1869-1936) born at Cleveland, Ohio, (U.S.A.), June 24, 1869, joined the staff of Vassar College Observatory and became Director in 1913. She compiled in 1900 a catalogue of stars within one degree of the north celestial pole. Her most important work was on variable stars. She was the author of a standard book on these objects. She died February 9, 1936.

GALILEI, Galileo de (1564-1642) was born at Pisa, (Italy), a cloth-merchant's son, February 15, 1564. Educated at Pisa University, he distinguished himself in mathematics and mechanics, and was in 1589 appointed Professor of Mathematics. His independence of thought soon manifested itself, and his opposition to the Aristotelian philosophy led to his dismissal. In 1592 he went to Padua as Professor of Mathematics in the University there. After the invention of the telescope, he was one of the first to use it for astronomical purposes. He discovered the mountains and plains on the Moon (1609), the satellites of Jupiter and the phases of Venus (1610), the spots on the Sun (1611), and the apparently triple nature of Saturn (1612). He settled in 1612 in Florence as "Mathematician to the Grand Duke of Tuscany", Having openly advocated the Copernican system, he was "cautioned" by the Papal authorities in 1616. A change in the papacy emboldened him in 1630 to publish his Dialogue on the Two Principal Systems of the World, in which the new system was openly advocated. For this, he was taken before the Inquisition and on June 22, 1633, was compelled to "renounce" his views. From that time, he was virtually a prisoner in his villa at Arcetri; but he continued his dynamical studies, and his great work on the laws of motion appeared in 1638. He died at Arcetri, January 8, 1642.

GALLE, Johann Gottfried (1812-1910) born at Pabsthaus, near Wittenberg, (Germany), June 9, 1812, was educated at Berlin University. He became in 1835 assistant to Encke, and noticed in 1838 the "dusky" ring of Saturn without fully realising the significance of his observation. He discovered three comets between 1839 and 1840, and in 1846, along with D'Arrest, found Neptune in the place predicted by Le Verrier. In 1851 he was appointed Director of Breslau Observatory, and in 1872 he was the first to use an asteroid for measuring the solar parallax. He retired in 1897 and died, aged 98, on July 10, 1910.



GAMBART, Jean Felix Adolphe (1800-1836) born at Cette Herault, (France), in May 1800, became in 1819 assistant at Marseilles Observatory, and in 1822 Director. He discovered 16 comets, including that of 1826, independently detected by Biela. He died in August 1836.

GAPOSCHKIN, Sergei (1899- ) born at Eupatona, Crimea, (Russia), on July 12, 1899, and educated at Berlin, was assistant at Berlin Observatory before his appointment as Research Assistant at Harvard, U.S.A. He married Cecilia Payne and has co-operated with her in her researches. He is co-author with her of a standard work on Variable Stars.

GASCOIGNE, William (1620-1644) born at Middleton, Yorkshire, (England), commenced the study of astronomy at the age of 18. He invented the micrometer. He was killed at the battle of Marston Moor, July 2, 1644.

GASSENDI, Pierre (1592-1655) born at Champtercier, (France), January 22, 1592, was educated for the priesthood and became a teacher of mathematics and philosophy. He was the first astronomer to observe a transit of Mercury. He wrote biographies of Copernicus and Tycho Brahe. He died in Paris, October 24, 1655.

GAUSS, Karl Friedrich (1777-1855) born at Brunswick, (Germany), April 30, 1777, studied at Göttingen and became in 1807 Director of the Observatory there. He became famous through his computation, in 1801, from a few observations, of the orbit of Ceres, the first of the asteroids, which led to its re-discovery. He is best remembered as the inventor of the "method of least squares". He died February 23, 1855.

GAUTIER, Jean Alfred (1793-1881) born at Geneva, (Switzerland), July 19, 1793, and educated at Paris, joined in 1819 the staff of Geneva Academy, and became first Director of the new Geneva Observatory. Failing sight forced him to retire in 1837, but he continued his work in astronomy, and was an independent discoverer of the identity of the sun-spot and magnetic cycles (1852). He died November 30, 1881.

GERASIMOVIC, Boris Petrovic (1889- ) born at Kremintschug, (Russia), March 19, 1889, and educated at Kharkov, worked at Harvard Observatory from 1922. There he investigated the long-period variable stars and the interstellar clouds. He became Director of Pulkova Observatory, Russia, in 1931.

GILL, David (1843-1914) born in Aberdeen, (Scotland), June 12, 1843, the son of a watchmaker, was educated at Aberdeen University. In 1872 he was appointed to direct Lord Lindsay's private observatory at Dunecht, Aberdeenshire. He observed the transit of



Venus at Mauritius in 1874, and in 1877, taking advantage of the unusual proximity of Mars, he went to Ascension Island, and made an accurate determination of the solar parallax. He became H.M. Astronomer at the Cape in 1879; there he carried through many important investigations. In 1882 he commenced his photographic Durchmusterung of the southern sky, completed with the aid of Kapteyn. Knighted in 1900, he retired in 1906, and in 1913, he wrote his History of the Cape Observatory. Recognised as one of the greatest astronomers of his age, he died January 24, 1914.

GOLDSCHMIDT, Hermann (1802-1866) born at Frankfort, (Germany), June 17, 1802, was trained for a commercial career, which he abandoned for art and astronomy. He settled in Paris, and, from the attic window of his studio, discovered 14 asteroids between 1852 and 1861. He died August 30, 1866.

GOODACRE, Walter (1856-1938) born at Loughborough, (England), succeeded his father in business as a carpet manufacturer. An enthusiastic amateur astronomer, he specialised in the study of the Moon. He published his great lunar map in 1910, and his authoritative handbook in 1932. Latterly he removed his observatory to Bournemouth, where he died May 1, 1938.

GOODRICK, John (1764-1786) was born of English parents at Groningen, (Holland), September 17, 1764. Deaf and dumb from birth, he became an astronomer in boyhood, and discovered the variability of the stars Beta Persei (Algol) and Delta Cephei. In the case of Algol he advanced in 1783 the theory that variability was due to periodic eclipses. He died at his home in York, April 20, 1786.

GORE, John Ellard (1845-1910) born at Athlone, (Ireland), June 1, 1845, and educated at Trinity College, Dublin, followed the profession of civil engineering and went to India in 1868. In 1879 he retired on pension from the Government service, and returning to Ireland, he devoted himself to astronomy. He discovered numerous variable stars and computed the orbits of many binaries. His work on cosmology was of enduring value and in his book The Visible Universe (1893) he summarised the state of cosmological knowledge. He was killed in a street accident in Dublin, July 18, 1910.

GOULD, Benjamin Apthorp (1824-1896) born in Boston, Massachusetts, (U.S.A.), September 27, 1824, graduated at Harvard in 1844 and studied astronomy in England, France and Germany. In 1855 he became Director of Dudley Observatory, Albany, New York, and in 1865 went to the Argentine to direct the National Observatory at Cordova. He compiled the great catalogue of southern stars known as the Uranometria Argentina. He was the first to draw attention to the existence of a belt of bright stars, slightly inclined to the Milky Way. Returning to the United States, he died November 27, 1896.



GRANT, Robert (1814-1892) born at Grantown-on-Spey, (Scotland), a tradesman's son, June 17, 1814, was educated at Aberdeen University. While serving in a business house in London, he contrived in his leisure to write a standard source-book, the History of Physical Astronomy. In 1859, he succeeded J.P. Nichol as Professor of Astronomy in Glasgow University, and Director of Glasgow Observatory. He was pre-eminently a practical astronomer, and compiled two star-catalogues. After his retirement, he returned to Grantown-on-Spey, where he died October 24, 1892.

GREAVES, William Michael Herbert (1897- ) born in Barbadoes, (British West Indies), September 10, 1897, and educated at Cambridge, was chief assistant at Greenwich from 1924 to 1938, when he succeeded Sampson as Astronomer-Royal for Scotland, and Professor at Edinburgh. His chief work has been on Saturn's rings and stellar temperature.

GREGORY, James (1638-1675) was born at Drumoak, Aberdeenshire, (Scotland), in November 1638. Educated in Aberdeen, he wrote a treatise which he took to London for publication in 1663, and in which he described the form of reflecting telescope known by his name, as the "Gregorian". After spending three years in Italy, he returned to Scotland as Professor of Mathematics in St. Andrews University. He was transferred in 1674 to the chair of mathematics in Edinburgh where he died suddenly in October 1675.

GREGORY, David (1661-1708), nephew of above, was born at Kinairdy, Banffshire, (Scotland), June 24, 1661. Educated at Aberdeen and Edinburgh Universities, he was in 1684 appointed Professor of Mathematics in Edinburgh where he expounded the Newtonian System before it was taught in Newton's own University of Cambridge. In 1692 he was appointed to a chair in Oxford, where he died October 10, 1708.

GRIMALDI, Francisco (1618-1663) born at Bologna, (Italy), April 2, 1618, and educated for the priesthood, entered the Jesuit order, and became Professor of Mathematics at Bologna. He constructed a map of the Moon, later published by Riccioli, and discovered the diffraction of light. He died December 28, 1663.

GROOMBRIDGE, Stephen (1755-1832) born at Goudhurst, Kent, (England), January 7, 1755, was an amateur astronomer who erected a private observatory at Blackheath. He commenced in 1806 the compilation of a catalogue of all stars of the eighth magnitude within fifty degrees of the north pole. Observations were completed in 1816, and the catalogue, containing 4243 stars, was published in 1838, six years after his death, which took place on March 18, 1832.

GYLDÉN, Hugo (1841-1896) born at Helsingfors (Finland), May 29, 1841, was assistant at Helsingfors and Pulkova before going to



Sweden as Director of Stockholm Observatory. His mathematical researches included the Earth's rotation and the orbits of the planets. His discussion of stellar proper motions led him in 1871 to the conclusion that the entire stellar system was in rotation - a theory fully confirmed in recent years. He died November 9, 1896.

HAGEN, Johann Georg (1847-1930) born at Bregenz, (Austria), March 6, 1847, was educated for the priesthood and ordained in 1878. Emigrating to America in 1880, he established a private observatory in Winconsin, where studied variable stars. In 1888 he went to Georgetown College Observatory, Washington, where he began to construct his atlas of variable stars. In 1906 he was summoned to Rome to direct the Vatican Observatory. In Rome he studied the nebulae, and drew attention to faint nebulosity in various parts of the sky. He died September 5, 1930.

HALE, George Ellery (1868-1938) was born in Chicago, (U.S.A.), June 29, 1868. He began his astronomical career as a boy, and studied the subject at Harvard, and then in Berlin. At the age of 23 he became famous by the invention of the spectroheliograph; he thus made it possible to photograph the Sun layer by layer, and to analyse the various strata in the solar atmosphere. In 1897 he was appointed Director of the Yerkes Observatory, and in 1905 was transferred to Mount Wilson where he supervised the erection of the great Observatory equipped with a 60-inch, and afterwards an 100-inch reflector. He surrounded himself with astronomers of outstanding ability whose work resulted in astonishing progress in several departments of the science. Among his own discoveries must be mentioned those of magnetic fields in sun-spots, (1908) and invisible sun-spots (1922). He outlined, in 1912 a "tentative working hypotheses" of sun-spots. After his retirement owing to a premature breakdown in health in 1923, he invented the spectrohelioscope. He died at Pasadena, California, February 21, 1938.

HALL, Asaph (1829-1907) born at Goshen, Connecticut, (U.S.A.), October 15, 1829, was apprenticed as a carpenter in boyhood. In 1856 he entered Michigan University, and studied astronomy there. After a period of service at Harvard, he was transferred in 1862 to the Washington Observatory. There, in 1876 he determined with great accuracy the rotation period of Saturn, and in August 1877 with the 26-inch telescope, he discovered Phobos and Deimos, the two small satellites of Mars. He retired from Washington in 1891, and became Professor at Harvard in 1896. He died November 22, 1907.



HALLEY, Edmund (1656-1742) born at Haggerston, London, (England), October 29, 1656, was educated at Oxford, and at the age of 20 went to St. Helena to study the southern stars. Later he devoted himself to the theory of gravitation, and assisted Newton financially in publishing the Principia. In 1703 he was appointed Professor at Oxford, and in 1705 published his work on comets announcing that the comet of 1682 revolved round the Sun in '75 or '76 years, and would again be seen in 1758, which prediction was fulfilled. The comet, by common consent, is named Halley's. In 1718 he detected the proper motions of four of the brighter stars. He also studied star-clusters, and in 1715, during the total eclipse of that year, he discovered the solar chromosphere and corona. He was appointed Astronomer-Royal in 1720, carried through an 18 years' programme of observations of the Moon's motion, and died at Greenwich, January 14, 1742.

HALM, Jacob Karl Ernst (1866- ) born at Bingen on the Rhine, (Germany), November 30, 1866, was educated at Kiel, and became assistant at Strasbourg Observatory in 1889. He went to Scotland in 1895 as assistant at the Royal Observatory, Edinburgh, and was in 1906 appointed as Chief Assistant at the Cape Observatory. While at Edinburgh, he re-determined the Sun's rotation by means of Doppler's principle, and at the Cape investigated the radial motions of the stars with special reference to Kapteyn's star-streams. In 1911 he found evidence of the existence of a third stream.

HANSEN, Peter Andreas (1795-1874) born at Tondern, (Denmark), December 8, 1795, taught himself mathematics and astronomy and became assistant at Altona Observatory in 1821. He was transferred to Seeberg, near Gotha in 1825. His researches were entirely mathematical, and he became the chief authority on the Moon's motion. He died at Gotha, March 28, 1874.

HARDING, Karl Ludwig (1765-1834) born at Lauenberg, (Germany), September 20, 1765, was educated for the Lutheran ministry. He was private tutor to J.H. Schröter's sons, and through Schröter became interested in astronomy. He was appointed assistant to Schröter at Lilienthal, and in 1804, discovered Junc, the third of the asteroids. Appointed to the chair of astronomy at Göttingen in 1813, he published an authoritative star-atlas in 1822. He also discovered 8 new nebulae. He died March 31, 1834.

HARRIOT, Thomas (1560-1621) born at Oxford, (England), became tutor to Sir Walter Raleigh, and took part in an expedition to Virginia. One of the earliest telescopic observers, he discovered sun-spots in 1610, independently of Galileo and Fabricius. He died in London in 1621.



HARTMANN, Johannes Franz (1865-1936) born at Erfurt, (Germany), January 11, 1865, acted as assistant in Leipzig and Vienna before going to Potsdam in 1896. He was transferred in 1909 as Director to Göttingen where he measured stellar and nebular radial velocities, and observed the transformation of Novae into "Wolf-Rayet" stars. His most important discovery was that of fixed lines of calcium in the spectrum of Delta Orionis which he rightly attributed to an intervening cloud of calcium vapour. He went to the Argentine in 1921 to superintend the National Observatory there. He returned to Germany in 1934, and died at Göttingen, September 13, 1936.

HARTWIG, Karl Ernst Albrecht (1851-1923) born at Frankfort, (Germany), January 14, 1851, was observer in Strasbourg and Dorpat before his appointment as Director at Bamberg (1886). Among his discoveries the most important was that of the nova in the Andromeda Nebula (1885). He died at Bamberg May 4, 1923.

HEIS, Eduard (1806-1877) born at Cologne, (Germany), February 16, 1806, was educated at Bonn University. He became in 1827 a schoolmaster in Cologne and in 1837 at Aachen. His astronomical attainments led to his appointment as Professor of Astronomy at Munster in 1852. He was a leading authority on variable stars, the Zodiacial light and meteors. He published a catalogue of 84 meteoric radiant-points in 1867 and a star-catalogue (Catalogus Stellarum) in 1872. His atlas of stars visible to the unaided eye (Atlas Coelestis Novus) contained 4943 stars from the north pole to 20 degrees south of the equator; it included also an elaborate delineation of the Milky Way as seen by the naked eye, with the galactic luminosity graded into five magnitudes. He died June 30, 1877.

HENCKE, Karl Ludwig (1793-1866) born at Driessen, (Germany), April 8, 1793, served as postmaster in his native town. An amateur astronomer, he began in 1830 to search for asteroids. In 1845 he discovered Astraea and in 1847 Hebe. He died September 21, 1866.

HENDERSON, Thomas (1798-1844) born at Dundee, (Scotland), December 28, 1798. A tradesman's son, he entered a law office, and in 1819 went to Edinburgh, where he held responsible legal and political posts. He became famous in astronomical circles by inventing a new method of calculating occultations. He was appointed H.M. Astronomer at the Cape in 1832, but after 15 months he resigned on account of health. During his year of office he constructed a catalogue of southern stars, and measured the parallax of the nearest star Alpha Centauri. He was appointed Professor of Astronomy in Edinburgh University and first Astronomer-Royal for Scotland in 1834. His measures of Alpha Centauri were not reduced until 1838, and his announcement of the



measurement of the distance of a star (January 3, 1839), was forestalled by that of Bessel concerning 61 Cygni. He died in Edinburgh, November 23, 1844.

HENRY, Paul (1848-1905) was born at Nancy, (France), August 21, 1848. He and his brother Prosper, were appointed assistants in the Paris Observatory in 1868. They constructed charts of stars down to magnitude 13 in the ecliptic zone, and discovered 14 asteroids. Later they continued their charting work by means of photography. Paul Henry died at Paris, January 4, 1905.

HENRY, Mathieu Prosper (1849-1903) brother of above, born at Nancy, (France), December 10, 1849, collaborated so closely with his brother that their contributions to astronomy cannot be separated. He died suddenly while on holiday in Savoy, July 25, 1903.

HERSCHEL, Friedrich Wilhelm (1738-1822) known to fame as Sir William Herschel, was born at Hanover, (Germany), November 15, 1738, the son of an army musician. A brilliant boy, unable to proceed further with his education owing to poverty, he entered the Hanoverian Guard as an oboe-player. After the battle of Hastedbeck (1757) he left Germany and crossed to England, where he became a church organist and music teacher in various towns, and latterly in Bath in 1766. A boyish love for astronomy was re-awakened by reading Ferguson's Astronomy; he constructed for himself reflecting telescopes of high perfection, and in 1774 he commenced his "reviews of the heavens". On March 13, 1781, in the course of one of these reviews, he discovered Uranus, the first planet to be discovered within human memory, and leapt from obscurity to fame. In 1782 he was appointed by George III to the post of King's Astronomer, specially created for him, with a residence near Windsor. During the next forty years he carried through an amazing and varied programme. His great telescopes far surpassed any previously constructed; the 40 foot reflector was one of the "world's wonders". He laid the foundations of the modern study of Mars (1777-1783), discovered two satellites of Saturn (1789), two of Uranus (1787), determined (1783) the proper motion of the Sun, and discovered (1802) the binary stars. He discovered and catalogued many star-clusters and nebulae, and outlined, in 1811, the nebular hypothesis of the development of nebulae into stars. As the result of his famous star-gauges, he advanced in 1786, his "disc-theory" of the stellar system. Subsequent research led him to modify this theory considerably, but he did not abandon it, as has been erroneously maintained by several authorities. It fell into disfavour in the latter part of the nineteenth century, but is now, in its main outline, generally accepted. He became naturalised as a British subject, and in 1788 married an English wife. Knighted in 1816, he died at Slough, near Windsor, August 25, 1822.



HERSCHEL, Caroline Lucretia (1750-1848) sister of above, born at Hanover, (Germany), March 16, 1750, went to England in 1772 as her brother's housekeeper. Later she collaborated with him in his astronomical works, and enormously lightened his labours. She discovered eight comets. After her brother's death, she returned to Hanover, and constructed a catalogue of the clusters and nebulae discovered by him. She died at Hanover, January 9, 1848.

HERSCHEL, John Frederick William (1792-1871) only son of Sir William Herschel, was born at Slough, near Windsor, (England), March 7, 1792. Educated privately and at Cambridge where he graduated in 1813, he took up the study of astronomy in 1816. He discovered 3347 double stars, and 525 nebulae. In 1832 he went out to South Africa to complete his father's work by gauging the southern skies. Returning to England in 1838, he devoted the remainder of his life to reducing and systematising his Cape observations, and later to the compilation of his General Catalogue of clusters and nebulae. His Outlines of Astronomy was for many years a standard work. He was created a knight in 1831, and a baronet in 1838. He died at Collingwood, in Kent, May 5, 1871. By his marriage to Margaret Brodie Stewart, daughter of a Scottish minister, he had twelve children.

HERSCHEL, Alexander Stewart (1836-1907) second son of above, was born at Feldhausen, (South Africa), February 5, 1836. Educated at Cambridge, he was Professor at Glasgow (1866-1871) and at Durham (1871-1886). His chief work was on meteors, on which he was a recognised authority. He died at Slough, June 18, 1907.

HERSCHEL, John (1837-1921) brother of above, and third son of Sir J. Herschel, was born at Feldhausen, (South Africa), October 29, 1837. By profession an engineer, he made in early life, while resident in India, spectroscopic observations of solar prominences and nebulae. In 1905 he edited papers by his grandfather, previously unpublished, on the brightness of the stars. His wife, who predeceased him by many years, wrote the memoir and edited the correspondence of Caroline Herschel, published in 1875. He died May 31, 1921.

HERTZSPRUNG, Ejnar (1873- ) was born at Frederiksberg, near Copenhagen, (Denmark), October 8, 1873. Appointed to the staff of Potsdam Observatory in 1909, he was later transferred to Leyden, and became Professor and Director of the Observatory in 1935. His most outstanding discovery was the division of the stars into the two main classes of giants and dwarfs (1905). He discovered in 1909 that the moving cluster in Ursa Major included Sirius; and in 1912 he pointed out the significance of the "period-luminosity law" of Cepheid variation.



HEVELIUS, Johann (1611-1687) born at Danzig, (Germany), January 28, 1611, educated at Danzig and later at Leyden University, spent three years travelling in England, France and Italy. From 1639 he gave all his spare time to astronomy, and established what was for a time the best-equipped observatory in Europe. He constructed a catalogue of 1500 stars, and a catalogue of all recorded comets. His Selenographia or description of the Moon was illustrated by his own drawings. His long telescopes were among the wonders of the age. His observatory was destroyed by fire in 1679, but he built and equipped another. He died January 28, 1687.

HILL, George William (1838-1914) born in New York, (U.S.A.), March 3, 1838, and educated at Harvard, joined the staff of the American Nautical Almanac in 1861. He did important work on the lunar theory and the orbits of the asteroids. He died April 16, 1914.

HIND, John Russell (1823-1895) born at Nottingham, (England), May 12, 1823, was assistant at Greenwich (1840-1843) and Regent's Park Observatory (1843-1853). He discovered the asteroids Iris and Flora in 1847 and the nova in Ophiuchus in 1848. He was appointed Superintendent of the Nautical Almanac in 1853. He died December 23, 1895.

HOEK, Martin (1834-1873) born at the Hague, (Holland), December 13, 1834, and educated at Leyden, became Professor of Astronomy at Utrecht in 1859. He first drew attention (1865) to the existence of "comet families". He died at Utrecht, September 4, 1873.

HOFFMEISTER, Friedrich Ludwig Cuno (1892- ) born at Sonneberg, Thuringia, (Germany), February 2, 1892, and educated at Jena, was assistant at Bamberg and Jena and became in 1930 Director of Sonneberg Observatory. He has observed, classified and investigated meteors and meteor-streams and has brought forward evidence that meteorites come from interstellar space.

HOLDEN, Edward Singleton (1846-1914) born at St. Louis, Missouri, (U.S.A.), November 5, 1846, was attached to Washington Observatory from 1873 to 1881. He became Professor of Astronomy in Wisconsin University in 1881. He was the first Director of the Lick Observatory (1886-1897). He accomplished important work on double stars, clusters and nebulae, and published an important monograph on the Orion nebula. He wrote a Life of W. Herschel and a synopsis of Herschel's writings. He died March 16, 1914.

HORROX, Jeremiah (1619-1641) born at Toxteth, near Liverpool, (England), studied at Cambridge for the Anglican ministry. He was an early adherent of the Copernican system. He predicted the



occurrence of a transit of Venus in 1639, and observed it himself. A career of great promise was cut short by his death, January 3, 1641.

HOUZEAU, Jean Charles (1820-1888) was born at Havre, near Mons, (Belgium), October 7, 1820. Educated at Brussels University, he erected a private observatory near Mons, and later became assistant at Brussels Observatory. He emigrated to America in 1857, and continued his astronomical work there. He returned to Belgium as Director of Brussels Observatory in 1876. He investigated meteor streams and the Zodiacal light, but his chief work was his authoritative atlas of all stars visible to the naked eye. He resigned in 1883, and died at Brussels, July 12, 1888.

HUBBLE, Edwin Powell (1889- ) born at Marshfield, Missouri, (U.S.A.), November 20, 1889, was educated at Chicago University. Assistant at the Yerkes Observatory from 1914 to 1917, he joined the staff of Mount Wilson Observatory in 1919. He discovered in 1923 that the irregular nebulae owe their brightness to the stars involved in them. With the 100-inch reflector, he resolved the Andromeda nebula into stars in 1924, detected Cepheid variables in it and afterwards fixed its distance at 680,000 light-years; he proved that this and other spirals are external galaxies. His survey of "sample areas" enabled him to catalogue 44,000 galaxies and to measure the distances of many out to 500 million light-years. Most of his conclusions are summarised in his book The Realm of the Nebulae (1936).

HUGGINS, William (1824-1910) born in London, (England), February 7, 1824, and educated privately, established in 1856 a private observatory at Tulse Hill, London. Here he commenced his pioneering work in spectroscopic astronomy, then in its infancy. He analysed in 1863 the chemical composition of Betelgeux and Aldebaran. In 1864 he detected bright lines in the spectrum of a planetary nebula, and later in the spectra of others, thereby proving their non-stellar, gaseous, nature. In 1868 he made the first measurements, by means of Doppler's principle of the radial motions of the brighter stars. He did important work on the solar chromosphere and prominences, and the atmospheres of the planets. Recognised as one of the greatest astronomers of his time, he was knighted in 1897. He died in London, May 12, 1910.

HUGGINS, Margaret Lindsay Murray or (1848-1915) born in Dublin, (Ireland), of a Scottish family, married the above in 1875. A competent astronomer, she was for 35 years her husband's sole assistant, and collaborated in all his researches. She died March 24, 1915.



HUMASON, Milton La Salle (1891- ) born in Dodge County, Minnesota, (U.S.A.), August 19, 1891, joined the staff of Mount Wilson Observatory in 1920. His chief work has been on external galaxies; he has classified their spectra and measured the radial motions of over 100. In 1932 and 1936 he photographed the spectra of supernovae in external galaxies.

HUSSEY, William Joseph (1862-1926) born at Mendon, Ohio, (U.S.A.), on August 10, 1862, and educated at Michigan University, joined the staff of the Lick Observatory in 1896. He became Director of Detroit Observatory in 1905. A specialist in the study of double stars, he discovered 1639 new pairs. He died October 29, 1926.

HYUGHENES, Christiaan (1629-1695) born at the Hague, (Holland), on April 14, 1629, the son of a famous Dutch statesman, studied at Leyden and became an astronomer in his early twenties. He greatly improved the telescope and before he was 30 discovered Saturn's ring-system and largest satellite (1655) and the Orion nebula (1656). He detected in 1659 markings on Mars, and measured the approximate rotation period. In 1659 he invented the pendulum clock; he invented also the eye-piece which bears his name. He settled in France in 1665, and while resident there put forward the wave theory of light. Returning to Holland on account of religious persecution in France, he died at the Hague on June 8, 1695. He held advanced views, maintaining that the stars were suns and that the Universe contained many inhabited worlds. His Cosmotheoros, published posthumously in 1698, summarizes his discoveries and theories.

INNES, Robert Thorburn Ayton (1861-1933) born in Edinburgh, (Scotland), November 10, 1861, emigrated to Australia in early life, and took up astronomy as a recreation. While resident in Sydney, he discovered 26 double stars. He joined the Cape Observatory staff in 1897, and was from 1903 in charge of Johannesburg Observatory. His discoveries included 1500 double stars and the faint star of rapid proper motion at first known as "Innes' star" (1916) and later as "Proxima Centauri", the Sun's nearest neighbour, a member of the Alpha Centauri system. He also investigated climatic variations. He retired in 1927 and settled in London, where he died March 13, 1933.

JACKSON, John (1887- ) born at Paisley, (Scotland), February 11, 1887, and educated at Glasgow and Cambridge Universities, was chief assistant at Greenwich from 1914 to 1933, when he went to the Cape as H.M. Astronomer. He is one of the leading authorities on double stars, and has investigated the origin of binary stars and of the Solar System.



JANSSEN, Pierre Jules César (1824-1907) born in Paris, (France), February 22, 1824, was a mathematical teacher in early manhood. Through physics he was led to the study of astronomy, and he became a pioneer of astronomical spectroscopy. In 1868 he observed for the first time the spectra of solar prominences without an eclipse, and placed beyond doubt the existence of the solar chromosphere. His great solar atlas (1904) contained 6000 photographs of regions of the Sun's surface. Director of Meudon Observatory from 1876, he died December 23, 1907.

JARRY-DESLOGES, René (1868- ) born at Sedan, (France), February 19, 1868, established about 1908 an observatory at Setif, in Algeria, where under excellent climatic conditions, he has specialised in visual observation of the planets. His work on Mars has been of the highest quality; he has mapped and detected many canals and other markings.

JEANS, James Hopwood (1877- ) born in London, (England), March 24, 1877, and educated at Cambridge, became lecturer in mathematics there in 1904. Later he spent four years in America as lecturer at Princeton. From 1919 to 1929 he was Secretary of the Royal Society. His researches in cosmogony attracted widespread attention from 1916 onwards. He developed the tidal theory of the origin of the Solar System. Knighted in 1928, he is Professor of Astronomy at the Royal Institution, London.

JEFFREYS, Harold (1891- ) born at Fatfield, Durham, (England), April 22, 1891, and educated at Newcastle and Cambridge, was employed in the Meteorological Office until 1922, when he returned to Cambridge as a Lecturer. He further developed Jeans' theory of evolution, and investigated the origin of the Moon. In 1923 he put forward his theory of the constitution of the giant planets, now generally accepted. He is the author of an authoritative text-book on The Earth.

JONES, Harold Spencer (1889- ) born in London, (England), March 22, 1889, and educated at Cambridge, became in 1913 chief assistant at Greenwich Observatory. In 1923 he was appointed H.M. Astronomer at the Cape, where he made an exhaustive study of Nova Pictoris (1925) and propounded the most plausible theory of novae yet advanced. In 1933 he succeeded Dyson as Astronomer-Royal for England. He has since investigated, among other subjects, the atmospheres of the planets.

KAISER, Frederik (1808-1872) born at Amsterdam, (Holland), June 10, 1808, and educated by an uncle who was an enthusiastic amateur, became himself an astronomer by profession. Appointed Director of Leyden Observatory, he observed double stars and the planets. His chief work was done on Mars, whose rotation



period he determined with great accuracy and whose surface he charted. Under him, the observatory was modernised and rebuilt. He died July 28, 1872.

KAPTEYN, Jacobus Cornelius (1851-1922) born at Barneveld, in Gelderland, (Holland), January 19, 1851, was educated at Utrecht University and appointed assistant at Leyden in 1875 and Professor of Astronomy at Groningen in 1877. Groningen University had no observatory, and he gave his spare time to co-operating with Gill in measuring and reducing the photographs for the Cape Photographic Durchmusterung. In 1896 he established an "Astronomical Laboratory" where photographs were classified and measured, and statistical investigations pursued. He was one of the greatest cosmologists of the time. In 1904 he announced his discovery of the two star-streams, and in 1910 the increase of velocity with advancing spectral type. He spent the last decade of his life in an attempt to solve the problem of the construction of the stellar system. In 1922, in conjunction with van Rhijn, he published his last and greatest paper, in which he outlined the shape and determined the extent of the "Kapteyn universe", the nearer portion of the galactic system. He retired in 1921, and died in Amsterdam, June 18, 1922.

KÄSTNER, Abraham Gotthelf (1719-1800) born at Leipzig, (Germany), September 27, 1719, was Professor of Mathematics at Göttingen for over fifty years. He wrote a History of Mathematics in four volumes, and investigated the Sun and sun-spots, the Moon and eclipses. Schröter and Olbers were among his pupils. He died at Göttingen, June 20, 1800.

KEELER, James Edward (1857-1900) was born at La Salle, Illinois, (U.S.A.), September 10, 1857. Educated at Baltimore University, he became assistant at Alleghany Observatory in 1881. He was appointed to the staff of the Lick Observatory in 1886, and returned to Alleghany as Director in 1891. He demonstrated by means of Doppler's principle the meteoric nature of Saturn's rings, theoretically proved by Roche and Clerk-Maxwell. He was appointed Director of the Lick Observatory in 1898. His photographic surveys, which resulted in the discovery of 120,000 new nebulae, half of them spiral, were cut short by his sudden death at San Francisco, August 12, 1900.

KEMPF, Paul Friedrich Ferdinand (1856-1920) born in Berlin, (Germany), June 3, 1856, became assistant at Potsdam Observatory in 1878. He devoted much attention to solar physics, and later, in conjunction with Müller, compiled a photometric Durchmusterung, giving visual magnitudes and colours of all stars in the northern sky down to magnitude 7.5. He died on February 16, 1920.



KEPLER, Johann (1571-1630) born at Weil der Stadt in Württemberg, (Germany), December 27, 1571, was the son of a dissolute soldier and experienced dire poverty in youth. He entered Tübingen University with a view to the Lutheran ministry. While a student, however, he turned his attention to astronomy, and in 1594 was appointed lecturer on that subject at Grätz. On account of his religious convictions, he was dismissed in 1598. In 1599 he became assistant to Tycho Brahe then in exile in Prague, and succeeded him in the post of Imperial Mathematician in 1601. He studied the nova of 1604 ("Kepler's star") and observed several comets, but his chief work was theoretical. From the priceless observations of Tycho Brahe he extracted the three laws of planetary motion. The first and second were announced in 1609, and the third in 1618. In 1612 he was appointed to a chair at Linz, in Austria, while retaining the post of Imperial Mathematician; but in 1626 he lost this chair, again on account of religious persecution. In 1629 he was appointed to a chair at Rostock University. He died at Ratisbon, Bavaria, November 15, 1630.

KIRCH, Gottfried (1639-1710) born at Guben, (Germany), December 18, 1639 and educated at Jena, was assistant to Hevelius at Danzig, and from 1705 Director of Berlin Observatory. He discovered the comet of 1680, and the variable star Chi Cygni in 1686; he was one of the earliest observers of star-clusters. He was assisted by his wife, who herself discovered a comet in 1702. He died July 25, 1710.

KIRCHHOFF, Gustav Robert (1824-1887) born at Königsberg, (Germany), March 12, 1824, and educated at Berlin and Marburg, became at an early age Professor of Physics at Heidelberg. In 1859 he carried through the decisive experiment which gave the clue to the "Fraunhofer lines" in the Sun's spectrum, and shortly afterwards he announced the general principles on which spectroscopy is based. He died at Heidelberg, October 17, 1887.

KIRKWOOD, Daniel (1814-1895) born in Harford County, Maryland, (U.S.A.), September 27, 1814, was Professor of Mathematics at Delaware College until 1856, when he was transferred to Indiana University. His chief work was on asteroids and meteors. As early as 1861 he declared that meteor-streams were "the débris of ancient, but now disintegrated comets". He died June 11, 1895.

KLEIN, Hermann Joseph (1844-1914) born in Cologne, (Germany), September 14, 1844, spent his whole career in his native city. He was Director of Cologne Observatory from 1902. He specialized in the study of the Moon and in 1879 obtained evidence of minute changes on the lunar surface. He also constructed a map of the Milky Way. He died at Cologne on July 1, 1914.



KLINKERFUES, Ernst Friedrich Wilhelm (1827-1884) born at Hofgeisnau, in Hesse-Cassel, (Germany), March 29, 1827, and educated at Göttingen, was appointed Director of Göttingen Observatory in 1859 and Professor of Astronomy in the University in 1861. He specialised in the study of comets and in 1872 announced that the shower of Andromedid meteors represented the remains of Biela's comet. He also computed double-star orbits and measured stellar parallaxes. He died on January 28, 1884.

KOBOLD, Hermann Albert (1858- ) born at Hanover, (Germany), August 5, 1858, was employed as assistant at O'Gyalla, Observatory, Hungary, from 1880, and transferred to Kiel in 1902. His chief works have been on the solar motion, and the rotation of the stellar system.

KOHLSCHÜTTER, Arnold (1883- ) born at Halle, (Germany), July 6, 1883, and educated at Göttingen University, spent three years at Mount Wilson Observatory, California, from 1911 to 1914. He co-operated with W.S. Adams in the work which led up to the measurement of the spectroscopic parallaxes of certain stars. In 1918 he was appointed to the staff of Potsdam Observatory, and in 1925 became Professor of Astronomy at Bonn and Director of the Observatory there.

KONKOLY, Nicolaus Von (1842-1916) born at Budapest, (Hungary), January 21, 1842, became a navigating officer on the Danube and was led from the study of meteorology to astronomy. He established the O'Gyalla Observatory which he handed over to the Hungarian Government in 1898 while retaining the directorship. He compiled a catalogue of stellar spectra and investigated the spectra of bright-line stars and meteors. He died February 16, 1916.

KOPFF, August (1882- ) born at Heidelberg, (Germany), February 5, 1882, and educated at Heidelberg University, became assistant to Max Wolf at Königstuhl Observatory. While at Heidelberg, he discovered numerous asteroids in co-operation with Wolf, and photographed nebulae. He left Heidelberg for Berlin where he became head of the "Astronomisches Rechen-Institute", a bureau for astronomical calculations.

KRÜGER, Carl Nicolaus Adalbert (1832-1896) born at Marienberg, (Germany), December 3, 1832, and educated at Berlin, became assistant to Argelander at Bonn in 1853. He was transferred to Helsingfors in 1862 and to Gotha in 1876. He determined a number of stellar parallaxes and published in 1893 a catalogue of 2153 red stars. He died April 21, 1896.

KÜSTNER, Freidrich (1856-1936) born at Görlitz, (Germany), August 22, 1856, and educated at Strasbourg, was appointed to the staff



of Berlin Observatory in 1884. He was appointed Professor of Astronomy at Bonn in 1891. His chief investigations related to the radial motions of the stars and the determination of star-positions. He discovered the variation of latitude in 1888. He retired in 1925 and died October 15, 1936.

LACAILLE, Nicolas Louis de (1713-1762) born at Rumigny, (France), March 15, 1713, studied for the priesthood, but through the influence of Jacques Cassini, turned to astronomy, and joined the staff of the Paris Observatory. In 1739 he became Professor at Mazarin College. He undertook, from 1750-1754, an expedition to the Cape during which he surveyed 10,000 southern stars, and compiled a catalogue of 2000 of these, with star-maps attached. He also detected formerly unknown clusters and nebulae. One of the greatest observers of his day, his premature death on March 21, 1762 was a severe blow to astronomy.

LAGRANGE, Joseph Louis de (1736-1813) born of a French family at Turin, (Italy), January 25, 1736, became, when a mere boy, professor at the Artillery School in that city. In 1764 he won a prize offered by the French Academy for an investigation of the libration of the Moon. In 1766 he went to Berlin as head of the mathematical department of the Academy there. In 1787 he returned to France settling in Paris, and in the following year his famous classic, the Mécanique Analytique was published. He demonstrated in 1782 the stability of the Solar System. He died April 10, 1813.

LALANDE, Joseph Jerome François (1732-1807) born at Bourg, (France), on July 11, 1732, was educated for a legal career, but chose astronomy for his life-work. He was editor of the Connaissance de Temps and afterwards Professor of Astronomy at the College de France. He published in 1801 his Histoire Celeste giving the places of 47,390 stars. Well-known as a populariser of astronomy, he died April 4, 1807.

LAMBERT, Johann Heinrich (1728-1777) born at Mulhausen, (Germany), on August 26, 1728, followed his father's trade as a tailor until 1748 when he became tutor in a nobleman's family. He went to Göttingen in 1751, and wrote extensively on astronomical subjects. In 1760 he described the Milky Way as "the ecliptic of the fixed stars" and he made some remarkably accurate estimates of stellar distances. In his treatise on Cosmology (1761) he set forth theories which modern research has shown to be sagacious "guesses". He settled in Berlin in 1764 and died there on September 25, 1777.



LAMONT, John (1805-1879) better known as Johann von Lamont, was born at Corriemulzie, Braemar, (Scotland), of Roman Catholic parents, December 13, 1805. At the age of 12 he was sent to Ratisbon in Bavaria, with a view to the priesthood, but he abandoned this project and studied astronomy at Munich. He joined the staff of Munich Observatory in 1830, and was appointed as Director in 1835. His main work was in practical astronomy, chiefly the measurement of the positions of stars in clusters. In 1850 he discovered the 11-years' magnetic period. He died August 6, 1879.

LAMPLAND, Carl Otto (1873- ) born in Dodge County, Minnesota, (U.S.A.), December 29, 1873, and educated at Indiana University, became Principal of Bloomfield High School in 1901. He joined the staff of the Lowell Observatory in 1903, and co-operated with Lowell in his work on Mars. In 1905 he secured the first photographs of the Martian canals. In 1924 and 1925, in co-operation with W.W.Coblentz, he succeeded in measuring the temperature of Mars.

LANGLEY, Samuel Pierpont (1834-1906) born at Roxbury, Massachusetts, (U.S.A.), on August 22, 1834, became assistant at Harvard Observatory in 1865. He was Director of Alleghany Observatory, Pittsburg, from 1866 to 1888, when he became Secretary of the Smithsonian Institution at Washington. A few years later, he founded the Smithsonian Astrophysical Observatory. He specialised in the study of the Sun and invented the bolometer. He died February 27, 1906.

LANSBERG, Philippe van (1561-1632) born at Ghent, (Belgium), August 25, 1561, was educated for the Protestant ministry and held charges at Antwerp and in Zeeland. Retiring from the ministry, he settled in Middelburg and devoted himself to astronomy. A strong supporter of the Copernican system, he constructed accurate tables of the Sun, Moon and planets. He died on November 8, 1632.

LAPLACE, Pierre Simon (1749-1827) born at Beaumont-en-Auge, near Honfleur, (France), March 22, 1749, became at the age of 18 a teacher in the Military School at Paris. His unique mathematical powers soon attracted attention, and he subsequently held various official positions. His Mécanique Céleste, published in five volumes (1799-1805) was a summation of all that had been achieved in theoretical astronomy since the time of Newton; he examined all the outstanding irregularities in the Solar System and found them explicable on the Newtonian law. In his Système du Monde (1796) he sketched the Nebular hypothesis of the origin of the Solar System. He died on March 5, 1827.



LASSELL, William (1799-1880) born at Bolton, Lancashire, (England), June 18, 1799, was by profession a brewer, who devoted his leisure time to observational astronomy. He specialised in the construction of reflecting telescopes, of which the chief was the 24-inch Newtonian with which on October 10, 1846, he discovered Triton, the satellite of Neptune. On September 19, 1848, independently of Bond, he detected Hyperion, Saturn's seventh satellite; and in 1851, he re-discovered Ariel and Umbriel, two of the satellites of Uranus. He died October 5, 1880.

LAU, Hans Emil (1879-1918) born at Odense, (Denmark), April 16, 1879, and educated at Copenhagen, established a private observatory at Horsholm, near Copenhagen, where he investigated double and variable stars and the planets Mars and Jupiter. He put forward a new theory of Jupiter's constitution. He died October 16, 1918.

LEAVITT, Henrietta Swan (1868-1921) born at Lancaster, Massachusetts, (U.S.A.), July 4, 1868, joined the staff of Harvard Observatory in 1902. She discovered 2400 variable stars and 4 novae and several asteroids. In 1912 she discovered the "period-luminosity law" of Cepheid variation which made possible the determination of great stellar distances. She died December 12, 1921.

LECOINTE, Georges (1869-1929) was born in Antwerp, (Belgium), April 29, 1869; after a military career he joined the Observatory staff of Uccle, of which he latterly became Director. His investigations dealt with the planets, star-charting and stellar distribution. He died May 27, 1929.

LEMAITRE, Georges Henri Joseph Edouard (1894- ) born at Louvain, (Belgium), July 17, 1894, and educated at Louvain University, was ordained to the priesthood, becoming abbot and afterwards canon. In 1927 he was appointed Professor at Louvain. He has specialised in cosmology and has shown that an expanding or contracting Universe is a necessary consequence of the Einstein theory.

LEUSCHNER, Armin Otto (1868- ) born at Detroit, Michigan, (U.S.A.), June 16, 1868, and educated at Michigan University, became in 1907, Professor in the University of California and Director of the "Students' Observatory" at Berkley. He has specialised in the computation of orbits and has rediscovered missing asteroids and lost comets.

LE VERRIER, Urban Jean Joseph (1811-1877) born at St. Lo, Normandy, (France), March 11, 1811, and educated in Paris, became a teacher of astronomy at the École Polétechnique in 1839. He commenced in 1845 to investigate the irregular motion of Uranus, and



concluded that this must be produced by the action of a more distant planet. The planet (Neptune) was detected at Berlin, September 23, 1846, during a search undertaken at his request; it had also been located independently by J.C. Adams. In 1853 Le Verrier became Director at the Paris Observatory. He paid much attention to meteors and computed in 1867 the orbit of the Leonid swarm. On account of his irritable disposition he was obliged to retire in 1870, but after the accidental death of his successor, Delaunay, in 1872 he was reinstated. He died in Paris, September 23, 1877.

LEXELL, Anders Johann (1740-1784) born at Abo, (Finland), went to Russia and was professor at St. Petersburg (Leningrad). He studied the orbits of comets, chiefly that of 1770 known by his name, and proved in 1781 that the new "comet" discovered by Herschel was actually a planet (Uranus). He died in 1784.

LINDBLAD, Bertil (1895- ) born at Örebo, (Sweden), November 26, 1895, was educated at Upsala University and became assistant in the observatory there. He spent two years at Mount Wilson, U.S.A., as volunteer assistant (1919-1921). He put forward in 1926 his theory of the rotation of the galactic system, and located its centre of gravity in Sagittarius, in agreement with Shapley's earlier and independent investigation. His results were confirmed, independently, by Oort. He has also studied the absorption of light in space. He was appointed Director of Stockholm Observatory in 1927. He put forward in 1935 a non-catastrophic theory of the origin of the Solar System from a cosmical cloud.

LITTRROW, Johann Joseph von (1781-1840) born at Bischofteinitz, (Bohemia), March 11, 1781, held appointments successively at Cracow, Kasan and Budapest before his appointment as Director of Vienna Observatory in 1819. One of the first astronomers to recognise the existence of the solar chromosphere, he was also noted as a popular writer on astronomy. He died November 30, 1840.

LITTRROW, Karl Ludwig von (1811-1877) son of above, was born at Kasan, (Russia), July 18, 1811. He became assistant to his father at Vienna Observatory in 1831. He specialised in the study of the asteroids, and computed the orbits of the more important of these. He also computed the orbits of comets. In 1842 he succeeded his father and died November 16, 1877.

LOCKYER, Joseph Norman (1836-1920) born at Rugby, (England), May 17, 1836, entered the War Office as a clerk in 1857, and devoted his leisure to astronomy. His earlier work was on Mars; later he took up astronomical spectroscopy. Independently of Janssen, he devised in 1868 a method of observing the spectra



of solar prominences without an eclipse. In 1869 he discovered the element helium. He was appointed to a Professorship at the Royal College of Science in 1881, and in 1885 Director of the Solar Physics Observatory, South Kensington. In 1890 he outlined his "meteoritic hypothesis" of stellar evolution. Knighted in 1897, he retired in 1913 to Sidmouth, Devon, where he erected a private observatory and where he died, August 16, 1920.

LOCKYER, William James Stewart (1868-1936) son of above, born in London, (England), January 3, 1868, and educated at Cambridge, became assistant to his father at South Kensington. He took part in nine eclipse expeditions. He co-operated with his father in establishing the private observatory at Sidmouth, of which he became Director in 1920. He died, July 15, 1936.

LOEWY, Maurice (1833-1907) born in Vienna, (Austria), April 15, 1833, and educated there, went to Paris in 1860 and joined the staff of the Paris Observatory. He effected instrumental improvements, invented the "equatorial coude" and became Director of the Observatory in 1896. He devoted special attention to lunar photography, in conjunction with Puiseux, and determined the solar parallax by means of observations of the asteroid Eros. He died October 15, 1907.

LOHRMANN, Wilhelm Gotthelf (1796-1840) born at Dresden, (Germany), January 31, 1796, was trained as a land-surveyor, but turned to astronomy, specialising in the study of the Moon. He projected a great chart of the lunar surface and published four out of 25 sections before failing eyesight compelled him to abandon the work. He died, February 20, 1840.

LOHSE, Wilhelm Oswald (1845-1915) born at Leipzig, (Germany), February 13, 1845, turned from chemistry to astronomy under the influence of Vogel. He was on the staff of Potsdam Observatory from 1874. He investigated double and temporary stars and experimented in planetary photography. He died May 14, 1915.

LONGOMONTANUS, Christian Sorensen (1562-1657) born at Longberg, (Denmark), October 4, 1562, a poor farmer's son, entered Copenhagen University at the age of 26 and became assistant to Tycho Brahe at Uraniborg in 1589. He assisted Tycho in his observations and computations and followed him into exile. Returning to Denmark, he was appointed Professor of Astronomy at Copenhagen and superintended the erection of the observatory there. He died October 8, 1657.

LOWELL, Percival (1855-1916) born at Boston, Massachusetts, (U.S.A.), March 13, 1855, of an old New England family, was educated at Harvard, and after spending several years in the



Far East, decided to devote the rest of his life to astronomy. Possessed of ample means, he founded and equipped in 1894 the Lowell Observatory at Flagstaff, Arizona. Here, for 22 years, he specialised in the study of the planets, particularly Mars. He mapped the planet persistently, discovered many "canals" and "oases", finally disproved the existence of permanent oceans, and became the leading authority on Mars. In three volumes, he put forward and developed his famous theory of intelligent life on Mars. He measured the rotation period of Mercury (88 days) and by means of the spectroscope he and V.M. Slipher in 1912 determined the rotation period of Uranus ( $10\frac{3}{4}$  hours). He published in 1915 his memoir on a trans-Neptunian planet, and indicated two possible regions of the sky in which it might be found. In one of these, in Gemini, the planet (Pluto) was detected at the Lowell Observatory early in 1930, over 13 years after his death, which took place suddenly, November 12, 1916.

LUEDENDORFF, Friedrich Wilhelm Hans (1873- ) born at Koslin, (Germany), May 26, 1873, was assistant at Hamburg and Potsdam Observatories, and in 1927 succeeded Müller as Director at Potsdam. He has devoted particular attention to variable stars, particularly those of long period. He retired in 1939.

LUNDMARK, Knut Emil (1889- ) born at Älfsbyn, Norrbotten, (Sweden), June 14, 1889, was educated at Upsala University and spent two years (1921-1923) in America as volunteer as assistant at Mount Wilson, where he investigated the novae in spiral nebulae, and amassed evidence in favour of the "island universe" theory of spirals. In 1924 he determined the distance of the Large Magellanic Cloud, and in 1925 obtained evidence for the rotation of the Galaxy round a centre in Sagittarius. He was appointed Director of Upsala Observatory in 1927, and of Lund Observatory in 1929.

LUTHER, Carl Theodor Robert (1822-1900) born at Schweidnitz, (Germany), April 16, 1822, was educated at Breslau and Berlin Universities, and was appointed Director of Dusseldorf Observatory in 1851. He discovered an asteroid (Thetis) in 1852, the first of 24 similar discoveries. He died February 15, 1900.

LUYTEN, Willem Jacob (1899- ) born at Semarang, Java, (Dutch East Indies), March 7, 1899, and educated at Amsterdam and Leyden, went to America and became assistant Professor at Harvard in 1923 and Professor of Astronomy at Minneapolis in 1931. He published in 1939 his catalogue of stars with very large proper motions. He has discovered 2500 variable stars and 1000 binary stars and has made an exhaustive survey of the neighbourhood of the Sun.



LYOT, Bernard (1897- ) born at Paris, (France), February 27, 1897, was educated at Paris University. Devoted to astronomy from 15 years of age, he became assistant at Meudon in 1920. He began in 1930, with the aid of his "coronograph" to photograph the solar corona in daylight. These attempts were crowned with success in 1931 and succeeding years. He has also studied the surface of the Moon with the polariscope and concluded that it is largely composed of pumice and volcanic ash.

MACLAURIN, Colin (1698-1746) born at Kilmodan, Argyllshire, (Scotland), was educated at Glasgow University, and at the age of 19 was chosen as Professor of Mathematics in St. Andrews University. In 1725 he was transferred to Edinburgh. One of the greatest mathematicians of his age he did much to verify and popularise the Newtonian theory. He observed the annular eclipse of 1737, and planned for the erection of an observatory in Edinburgh. When the rebellion of 1745 broke out, Maclaurin, a strong anti-Jacobite, left Edinburgh and took refuge at York, where he died June 14, 1746.

MCCLEAN, Frank (1837-1904) born in London, (England), educated at Glasgow and Cambridge, was an engineer by profession. He surveyed the spectra of all stars above magnitude 3.5 in both hemispheres and investigated the distribution of the various spectral types. He died November 8, 1904.

MACLEAR, Thomas (1794-1879) born at Newtown-Stewart, Tyrone, (Ireland), March 17, 1794, abandoned medicine for astronomy and was appointed in 1833 H.M. Astronomer at the Cape. He verified Henderson's parallax of Alpha Centauri, and observed comets and nebulae. Knighted in 1860, he retired in 1870 and died July 14, 1879.

McMATH, Robert Reynolds (1890- ) born at Detroit, Michigan, (U.S.A.), May 11, 1890, has been, since 1931, Director of McMath-Hulbert Observatory at Pontiac. By means of the "tower telescope" he has secured motion-pictures of the solar prominences.

MÄDLER, Johann Heinrich von (1794-1874) was born in Berlin, (Germany), May 29, 1794. Left an orphan at 18, with three young sisters to support, he did not enter the University of Berlin till he was 24. In 1822 he became a teacher in Berlin. He gave private lessons in astronomy to Wilhelm Beer, along with whom he made exhaustive observations in Beer's private observatory on Mars and the Moon. Their work on the Moon issued in 1837 in the publication of their standard work Der Mond, with chart accompanying. Up to date this was the most important



contribution yet made to lunar astronomy. In 1840 Mädler went to Dorpat (Tartu) in Estonia as Professor of Astronomy and Director of the Observatory. Here he grappled with cosmology, and put forward in 1846 his theory of the "central sun" which he identified with Alcyone, the brightest of the Pleiades. He retired in 1865 and returned to Germany, devoting his last years to writing his authoritative History of Astronomy. He died at Hanover, March 14, 1874.

MAGGINI, Mentore (1890- ) born at Empoli, (Italy), February 6, 1890, became assistant at Florence in 1907 and Director of Teramo Observatory in 1926. He has specialised in lunar and planetary work and has investigated the question of changes in the Moon.

MALMQVIST, Karl Gunnar (1893- ) born at Ystad, (Sweden) February 21, 1893, and educated at Lund, was assistant at Lund Observatory from 1920, and became observer at Stockholm in 1931. He has investigated globular clusters and the solar motion.

MARALDI, Giacomo Filippo (1665-1729) born at Perinaldo, (Italy), August 21, 1665, was a nephew of G.D.Cassini. He was a careful observer of the planets and made in 1719 the first recorded observations of the polar caps of Mars. He assisted his uncle at the Paris Observatory. He died December 1, 1729.

MARALDI, Giovanni Domenico (1709-1788) son of above, born at Perinaldo, (Italy), April 17, 1709, was employed at the Paris Observatory, and made long-continued observations of Jupiter's satellites. He died on November 14, 1788.

MASKELYNE, Nevil (1732-1811) born in London, (England), October 6, 1732, was educated at Cambridge, with a view to entering the Anglican ministry. Turning his attention to astronomy, he went to St.Helena in 1761, at the instigation of Bradley, to observe the transit of Venus and during the voyage, he devised a method of finding longitude at sea. He was appointed Astronomer-Royal for England in 1765, and inaugurated the Nautical Almanac in 1767. He made in 1774 his famous "Schiehallion experiment" in Scotland with a view to determining the mass and density of the Earth. He died February 9, 1811.

MASTLIN, Michael (1550-1631) born at Göppingen, Württemberg, (Germany), studied in Italy, where he became intimate with Galileo. Later he was Professor at Tübingen, and had Kepler as a pupil. He was one of the earliest advocates of the Copernican system, and a discoverer and observer of the temporary star of 1604 ("Kepler's star"). He was the first to give an explanation of the phenomenon of "the old moon in the new moon's arms". He died in 1631.



MAUNDER, Edward Walter (1851-1928) born in London, (England), April 12, 1851, and educated at King's College, London, entered Greenwich Observatory in 1873. His earlier work was on cometary spectra and stellar radial motions. Later he became Superintendent of the "solar department" at Greenwich. In 1903 and 1904 he investigated the relationship between sun-spots and terrestrial magnetic disturbances, and concluded that these are caused by electrical particles streaming outwards in radial lines from sun-spots. He wrote a book on the Astronomy of the Bible. He retired in 1913 and died on March 21, 1928.

MAUNDER, Annie Scott Dill Russell or (1868- ) wife of above, born at Strabane, Co. Tyrone, (Ireland), April 14, 1868, and educated at Girton College, Cambridge, joined the staff of Greenwich Observatory in 1891. She married E.W.Maunder in 1895, and co-operated with him in his work on the Sun. She is a noted authority on the history of ancient astronomy.

MAURY, Antonia Caetano (1867- ) born at Cold Spring-on-Hudson, New York, (U.S.A.), March 21, 1867, and educated at Harvard, was appointed assistant at Harvard Observatory in 1889, in which year she had a share in the discovery of the first spectroscopic binary star. She discovered in 1897 the so-called "c. characteristic" in the spectra of giant stars.

MAYER, Christian (1719-1783) born at Mesritz, (Germany), August 26, 1719, became Professor at Heidelberg and afterwards "State Astronomer" at Mannheim. He published in 1777 a list of double stars, which he believed to be binaries, an opinion rejected at the time, but vindicated by W. Herschel in 1802. He died April 16, 1783.

MAYER, Simon (1570-1624) also known as Simon Marius, born at Gunzenhausen, (Germany), studied astronomy under Tycho Brahe and Kepler, and became "Court Astronomer" to the Margrave of Brandenburg. He was one of the first to use the telescope, and appears to have detected the satellites of Jupiter, independently of Galileo. In 1612 he discovered the Andromeda nebula. He died in 1624.

MAYER, Tobias (1723-1762) born at Marbach, Würtemberg, (Germany), February 17, 1723, was left an orphan in childhood and supported himself by teaching mathematics. He was appointed in 1751 as Director of the new observatory at Göttingen. Here he compiled a star-catalogue and obtained evidence of the proper motions of 80 stars. In 1753 he published new solar and lunar tables. He carefully studied the Moon and made a fine lunar chart. He died February 20, 1762.



MECHAIN, Pierre François André (1744-1805) born at Laon, (France), April 16, 1744, joined the staff of the Paris Observatory when a young man and became famous as a "comet-hunter". He discovered 8 comets between 1781 and 1799. He died on September 20, 1805.

MELOTTE, Philibert Jacques (1880- ) born in London, (England), January 29, 1880, joined at an early age the staff of Greenwich Observatory. He discovered in 1908 the eighth satellite of Jupiter. He has investigated stellar distribution, and compiled in 1915 a catalogue of clusters.

MERRILL, Paul (1887- ) born at Minneapolis, Minnesota, (U.S.A.), August 15, 1887, joined the Mount Wilson staff in 1917. His chief work has been on long-period variable stars; he detected bright lines in their spectra and advanced a theory of their variations.

MESSIER, Charles (1730-1817) born at Badmirelly, Lorraine, (France), June 26, 1730, spent his active life at the Paris Observatory. He discovered 13 comets between 1760 and 1798. He compiled in 1781 his famous catalogue of star-clusters and nebulae, with a view to preventing confusion between these objects and comets. He died April 12, 1817.

METCALF, Joel Hastings (1866-1925) born at Meadville, Pennsylvania, (U.S.A.), on January 4, 1866, and educated for the ministry of the Unitarian Church, became a prominent leader in that denomination. Pursuing astronomy as a recreation, he constructed his own telescopes and discovered several comets and variable stars and 41 asteroids. He died February 4, 1925.

MICHELL, John (1725-1793) born in Nottinghamshire, (England), was educated at Cambridge for the Anglican ministry. An acute thinker on astronomical problems, he demonstrated the extreme probability that many close double stars are binaries. He died on April 21, 1793.

MICHELSON, Albert Abraham (1852-1931) born at Strelno, (Germany), December 19, 1852, was taken to America when an infant by his parents. He became Professor at Cleveland and later at Chicago. He performed in 1887 the famous "Michelson-Morley experiment" to detect the Earth's motion through the hypothetical ether. His application of the interferometer to astronomy resulted in the measurement of the diameters, by Pease, of Betelgeux and other stars. He died May 9, 1931.

MILNE, Edward Arthur (1896- ) born at Hull, (England), February 14, 1896, became, after graduation at Cambridge, professor at Manchester, and in 1928, at Oxford. He has made important contributions to theoretical astronomy and has studied the white dwarf stars, cosmic rays, and the structure of the Universe.



MINEUR, Henri (1899- ) born at Lille, (France), March 7, 1899, and educated in Paris, joined the staff of the Paris Observatory in 1921. He has investigated the "local cluster" and has shown that it probably rotates round its own centre of gravity in addition to its revolution round the stellar centre in Sagittarius.

MINNAERT, Marcel Gillies Jozef (1893- ) born at Bruges, (Belgium), on February 12, 1893, was observer at Utrecht from 1919, and became in 1937 Professor of Astronomy and Director of the Observatory. He has investigated the temperature and constitution of the Sun.

MITCHELL, Maria (1818-1889) born at Nantucket, Massachusetts, (U.S.A.), August 1, 1818, co-operated with her father, an amateur astronomer. She became famous in 1847 by her discovery of a comet, and was in 1865 appointed Director of Vassar College Observatory. She was America's first woman astronomer. She died June 28, 1889.

MÖLLER, Didrik Magnus Axel (1830-1896) born at Schonen, (Sweden), February 10, 1830, was educated at Lund University and associated throughout his life with that institution. He was appointed Professor of Astronomy in 1863. His chief work was mathematical, on the perturbations of the planets. He died October 25, 1896.

MONTANARI, Geminano (1633-1687) born at Modena, (Italy), June 1, 1633, was Professor of Mathematics at Bologna and later at Padua. He constructed a map of the Moon and in 1669 discovered the variability of Algol (Beta Persei). He died October 13, 1687.

MOUCHEZ, Amédée (1821-1892) born of French parentage at Madrid, (Spain), August 24, 1821, entered the French Navy and rose to the rank of Admiral. He joined the staff of the Paris Observatory and was chosen as Director in 1878. He had a large share in the inception of the international Astrographic Chart. He died June 29, 1892.

MÜLLER, Karl Hermann Gustav (1851-1925) born at Schweidnitz, Silesia, (Germany), May 5, 1851, was educated at Berlin University and assisted Vogel in the Astrophysical Observatory at Potsdam from 1877. He began in 1886, assisted by Kempf, the construction of the Potsdam Durchmusterung, giving visual magnitudes and colours of all stars in the northern sky down to magnitude 7.5. He compiled a catalogue of 1615 variable stars, and did pioneer work in planetary photometry. Director of the Observatory from 1916 to 1921, he died on July 7, 1925.



NAPIER, John (1550-1617) born at Merchiston Castle, Edinburgh, (Scotland), and educated at St. Andrews University, travelled on the Continent in his youth. Settling down at his family seat of Merchiston, he devoted his attention to many subjects, wrote on theology and politics, and investigated various branches of science. Concentrating on astronomy, he spent much time in devising methods of facilitating and shortening calculations. These efforts were successful, and the invention of logarithms was announced in 1614. The invention was of great assistance to Kepler, and made possible the rapid development of astronomy in the 17th century. Napier died in Edinburgh, April 3, 1617.

NEVILL, Edmund Neville (1851- ) originally Neison, born in London, (England), August 27, 1851, completed in 1876 his handbook on The Moon, with map. Later he became Government Astronomer of Natal, retiring in 1912.

NEWALL, Hugh Frank (1857- ) born at Gateshead, (England), June 21, 1857, was assistant Professor at Cambridge, and later Professor of Astrophysics (1909-1928) and Director of the Solar Physics Observatory from 1913 to 1928. He discovered in 1900, independently of Campbell, the duplicity of Capella. His investigations on the solar corona led him to the conclusion that its light is mainly reflected.

NEWCOMB, Simon (1835-1909) born at Wallace, Nova Scotia, (Canada), March 12, 1835, and educated at Harvard, was appointed Professor of Mathematics in the U.S. Navy and observer at Washington Observatory in 1861. Later he was Professor at Baltimore, while retaining his post at Washington. His chief work was in mathematical astronomy, and he discussed the orbits of the asteroids, of Uranus and Neptune and the lunar theory. He made a determination of the solar parallax from observations on Mars in 1865. In his later years, cosmological theory occupied much of his time, and he wrote a valuable work on The Stars in 1901. He retired in 1897 and died July 11, 1909.

NEWTON, Hubert Anson (1830-1896) born at Sherburne, New York, (U.S.A.), March 19, 1830, and educated at Yale University, was appointed Professor of Astronomy at Yale in 1855. He computed the orbit of the Leonid meteors and predicted a great shower for November 12-13, 1866, which prediction was fulfilled. An acknowledged authority on comets and meteors, he died August 12, 1896.

NEWTON, Isaac (1642-1727) born at Woolsthorpe, near Grantham, Lincolnshire, (England), December 25, 1642, was intended by his widowed mother to be a farmer; obviously unfitted for this line of life, he proceeded with his education at Grantham and later



at Cambridge University, where he graduated in 1665. In student days his mind was exercised by the problem of gravitation, but his first efforts at formulating a "law" proved abortive. For several years, he gave his chief attention to optics and may be considered the discoverer of the solar spectrum. In 1666 he procured a prism and dispersed sunlight into its primary colours. About the same time he invented the reflecting telescope, independently of Gregory, and the first reflector ever made was constructed by him at the end of 1668. A second was completed in 1671. He was appointed Professor of Mathematics in 1669. In 1673 his interest in gravity was re-awakened, and Picard's determination of the value of the Earth's radius enabled him to proceed with his quest. Having formulated the law of gravitation, he commenced to write the Principia, published in July 1687. In this classic, he showed that the laws of planetary motion formulated by Kepler and those of falling bodies on the Earth were necessary consequences of his own law. The distinction between "the heavens" and "the Earth" was thus abolished. He gave the first satisfactory explanation of the tides. He entered Parliament as a Whig in 1687 but his political career was of short duration. In 1696 he resigned his professorship at Cambridge to become Warden of the Mint, and in 1699 he was appointed Master. His astronomical work was really completed before he was 50, and he devoted his spare time to periodical revisions of the Principia. Knighted in 1705, he died in London, March 20, 1727.

NICHOL, John Pringle (1804-1859) born at Brechin, (Scotland), January 13, 1804, and educated at Aberdeen University, was appointed Rector of Montrose Academy at the age of 20. His high reputation as an astronomer led to his appointment as Professor of Astronomy in Glasgow University and Director of Glasgow Observatory in 1836. He wrote extensively, chiefly on cosmology, and defended the nebular theory in its time of unpopularity. He died at Rothesay, September 19, 1859.

NICHOLSON, Seth Barnes (1891- ) born at Springfield, Illinois, (U.S.A.), November 12, 1891, and educated at the University of California, served for a short time at the Lick Observatory, where he discovered in 1914 the ninth satellite of Jupiter. In 1915 he was appointed to Mount Wilson. He has specialised in solar astronomy and the determination of stellar and planetary temperatures. He discovered in 1938 the very faint tenth and eleventh satellites of Jupiter.

NIESTEN, Jean Louis Nicholas (1844-1920) born at Vise, Liege, (Belgium), July 4, 1844, joined the staff of Brussels Observatory in 1878, and in that year discovered the "Great Red Spot" on Jupiter. He was an assiduous observer of the planets, especially Venus. He died December 27, 1920.



NIJLAND, Albert Antonie (1868-1936) born at Utrecht, (Holland), October 30, 1868, and educated there, became Director of Utrecht Observatory in 1898. He became one of the foremost observers of variable stars, and a leading authority on these objects. He died August 18, 1936.

NYRÉN, Magnus (1837-1921) born at Brunskog, (Sweden), February 21, 1837, and educated at Upsala, went to Russia in 1871 to serve at Pulkova. He confirmed in 1893 the existence of the variation of latitude; he also re-determined the constants of precession and aberration. He retired in 1908 and returned to Sweden. He died January 16, 1921.

OLBERS, Heinrich Wilhelm Matthias (1758-1840) born at Arbergen, near Bremen, (Germany), October 11, 1758, was a Lutheran minister's son and took up astronomy when he was 13. He studied medicine at Göttingen and Vienna, and set up in medical practice in Bremen in 1781. He devised a new method of calculating cometary orbits in 1779. All his life an amateur, he established a private observatory on the roof of his house in Bremen and there he rediscovered the asteroid Ceres and its companion Pallas (1802) and Vesta (1807). He discovered the comet of 1817 (Olbers' comet), which turned out to be periodic and returned in 1887. His work on comets was epoch-making and in 1811 he showed that comets' tails are streams of minute particles driven off from the heads by a "repulsive force" which, he maintained, resided in the Sun. He died March 2, 1840.

OLIVIER, Charles Pollard (1884- ) born at Charlottesville, Virginia, (U.S.A.), April 10, 1884, was educated at Virginia University. In 1914 he was appointed associate Professor of Astronomy in that institution and in 1928 was transferred to the University of Pennsylvania as Professor and Director of the Flower Observatory. The leading authority on meteors, he has catalogued 1200 separate meteor-streams and has written an authoritative work on the subject (1925).

OLMSTED, Denison (1791-1859) born at East Hartford, Connecticut, (U.S.A.), June 18, 1791, and educated at Yale, was for a time Professor in North Carolina and afterwards Professor of Mathematics at Yale. He observed the great meteor shower of 1833 and discovered that the meteor radiated from a point near the star Gamma Leonis, thus finally disproving the terrestrial theory of meteors. One of the early pioneers of astronomy in America, he died May 13, 1859.

OORT, Jan Hendrik (1900- ) born at Franeker, (Holland), April 28, 1900, was educated at Groningen and Yale, and became assistant



to van Rhijn at Groningen in 1921. He was appointed to the staff of Leyden Observatory in 1924. His chief work has been on the structure and rotation of the Galaxy. In 1927, after an exhaustive study of radial motions, he located the stellar centre among the star-clouds of Sagittarius, in agreement with Shapley's earlier and independent work; round this centre the Sun appears to revolve in about 220 million years. He became Associate Director of Leyden Observatory in 1935.

OPPOLZER, Theodor Ritter von (1841-1886) born at Prague, (Bohemia), of German origin, October 26, 1841, became Professor of Astronomy in Vienna. His most important work was his Canon of Eclipses, containing every solar and lunar eclipse visible between 1203 B.C. and 2163 A.D. He also computed the orbits of 56 asteroids. He died December 26, 1886.

OPPOLZER, Egon Ritter von (1869-1907) son of above, born in Vienna, (Austria), and educated at Vienna and Munich, became in 1897 assistant at Prague Observatory, where he discovered the variability of the asteroid Eros. Appointed Professor of Astronomy at Innsbruck in 1901, he died there June 15, 1907.

ORIANI, Barnabo (1752-1832) born near Milan, (Italy), of humble parentage, was educated by the local monks and became an abbot. Turning his attention to astronomy, he was appointed to the Brera Observatory, Milan, in 1776. He computed the orbits of Uranus and the asteroid Ceres. He died in 1832.

OUDEMANS, Jan Abraham (1827-1906) born at Amsterdam, (Holland), December 16, 1827, and educated at Leyden University, became Professor of Astronomy at Utrecht in 1856. He resigned in 1857 in order to proceed to Java on geodetic work, and returned to his chair in 1875. His main work was in fundamental astronomy; he determined stellar parallaxes and computed comets' orbits. He retired in 1898 and died December 14, 1906.

PALISA, Johann (1848-1925) born at Troppau, (Austria), December 6, 1848, became assistant in Vienna Observatory in 1870. Transferred to Pola in 1872, he returned to Vienna in 1880. He discovered well over 100 asteroids. He died May 2, 1925.

PANNEKOEK, Antonie (1873- ) born at Vaasen, Gelderland, (Holland), January 2, 1873, graduated at Leyden in 1912. He became lecturer in Amsterdam University in 1919. Professor in 1925, and Director of the Astronomical Institute in 1931. His study of the dark obscuring clouds of the Milky Way led him to the conclusion that they are composed of dust. He has also investigated the solar chromosphere.



PAYNE-GAPOSCHKIN, Cecilia (1900- ) born at Wendover, (England), May 10, 1900, and educated at Newnham and Radcliffe Colleges, went to America in 1923, and became Research Assistant at Harvard Observatory in 1927, and "Phillips Astronomer" in 1937. She married Sergei Gaposchkin. Her researches have included pressure in stellar atmospheres and the chemical composition of the stars. She is co-author with her husband of a standard work on Variable Stars.

PEASE, Francis Gledheim (1881-1938) born at Cambridge, Massachusetts, (U.S.A.), January 14, 1881, and educated in Illinois, became observer in the Yerkes Observatory in 1901 and was transferred to Mount Wilson in 1904. He co-operated with Shapley in 1916 and 1917 in the study of star-clusters, and in 1920, by means of the interferometer, measured the diameter of Betelgeux. He secured fine photographs of the Moon with the 100-inch reflector. A highly-skilled telescope designer, he was largely responsible for the 100-inch reflector and has been called "the father of the 200-inch telescope". He died February 7, 1938.

PECK, William (1861-1925) born at Argennan, near Castle-Douglas, (Scotland), January 3, 1861, was educated in Edinburgh, and when a young man, became Director of a private observatory in that city. In 1889 he was appointed Astronomer to the City of Edinburgh and Director of the City Observatory. His main work was star-charting. In 1898 he mapped 9000 stars in his Observer's Atlas of the Heavens. Later, in conjunction with Backhouse, he catalogued and charted all stars visible to the unaided eye, with magnitudes reduced to a standard scale. He was knighted in 1917, and died March 8, 1925.

PELTIER, Leslie (1900- ) born at Delphos, Ohio, (U.S.A.), January 2, 1900, a farmer's son, became an amateur astronomer at the age of 18. He became famous as an observer of long-period variable stars and a comet hunter. He discovered seven comets, among them the bright comet (Peltier's) of 1936 and two novae.

PERRINE, Charles Dillon (1867- ) born at Steubenville, Ohio, (U.S.A.), July 28, 1867, joined the staff of the Lick Observatory in 1901, and became Director of the Argentine National Observatory at Cordova in 1909. He discovered in 1905 the sixth and seventh satellites of Jupiter. He put forward in 1918 a new theory of stellar evolution.

PERROTIN, Henri (1845-1904) born at St. Loup, Tarn-et-Garonne, (France), December 19, 1845, was assistant at Toulouse before his appointment as the first Director of the Nice Observatory. A specialist in planetary work, he confirmed in 1886



Schiaparelli's discovery of the canals of Mars. He studied Venus and Uranus, discovered numerous asteroids and observed double stars and nebulae. He died at Nice, February 29, 1904.

PETERS, Christian August Friedrich (1806-1880) born at Hamburg, (Germany), September 7, 1806, studied at Königsberg under Bessel and became Director of Altona Observatory. He was transferred to Kiel in 1878. He was an expert in the measurement of stellar parallax, and made many determinations. He demonstrated the existence of an unseen companion to Sirius in 1851. He died May 8, 1880.

PETERS, Christian Heinrich Friedrich (1813-1890) born at Coldenbuttle, Schleswig, (Denmark), September 19, 1813, and educated at Berlin University, became assistant at Göttingen. Emigrating to America in 1848, he was employed at Clinton and Litchfield Observatory. He discovered 48 asteroids. He died July 19, 1890.

PETTIT, Edison (1890- ) born at Peru, Nebraska, (U.S.A.), September 22, 1890, and educated at Chicago, joined the staff of Mount Wilson Observatory in 1920. In collaboration with Nicholson, he determined the temperature of Mars in 1924. He has specialised in the measurement of lunar, planetary and stellar radiation, and in the observation of solar prominences.

PHILLIPS, Theodore Evelyn Reece (1868- ) born at Kibworth, Leicestershire, (England), March 28, 1868, was educated for the ministry of the Church of England. Ordained in 1891, he became Rector of Headley in 1916. A high authority on Mars, Jupiter and Saturn, he has done important work on variable stars. In 1916 he analysed the light-curves of 80 long-period variables and divided them into two groups.

PIAZZI, Giuseppe (1746-1826) born at Ponte in the Valtelline, (Italy), July 16, 1746, early in life entered a monastic order. He was appointed Professor of Mathematics at Palermo, Sicily, in 1780 and soon afterwards an observatory was built. He undertook the compilation of a star-catalogue, and while employed on this work, discovered the first of the asteroids, Ceres, on January 1, 1801. His first star-catalogue was published in 1803 and his second in 1814. He died at Naples, July 22, 1826.

PICARD, Jean (1620-1682) born at La Fleche, Anjou, (France), July 21, 1620, studied for the priesthood and was ordained. He was appointed Professor in the College de France in 1645 and took a leading part in the establishment of the Paris Observatory. His greatest piece of work was his accurate determination of the radius of the Earth (1669-1670) which enabled Newton to complete his work on gravitation. He died as the result of an accident July 12, 1682.



PICKERING, Edward Charles (1846-1919) born at Boston, Massachusetts, (U.S.A.), July 19, 1846, of an old New England family, graduated at Harvard in 1865 and was appointed Professor of Physics in the Massachusetts Institute of Technology. In 1876 he became Professor of Astronomy at Harvard and Director of the Observatory. During the long period of his directorship - 43 years - he made investigations and discoveries in many branches of Astronomy. Stellar photometry, variable stars, and the classification of stellar spectra claimed his attention. In 1889 the first two spectroscopic binaries - Mizar (Zeta Ursae Majoris) and Beta Aurigae were discovered. Under his direction, the Harvard Observatory was re-organised and the scope of its activities enormously widened. A southern station at Arequipa, Peru, was set up in 1891. In the famous Draper Catalogue, the stars were classified according to their spectra and arranged in the "Harvard Sequence". Active to the end, he died February 3, 1919.

PICKERING, William Henry (1858-1938) brother of above, was born at Boston, Massachusetts, (U.S.A.), February 15, 1858. He became assistant to his brother in 1887. For some time he was in charge of the Harvard station at Arequipa, Peru, where he observed Mars carefully in 1892, discovering the "lakes" or "oases" at the junctions of the canals. In 1898 he collaborated with Lowell in observing at Flagstaff and finally proved that the so-called "seas" were non-aqueous. In 1898 he discovered Phoebe the ninth satellite of Saturn. His chief work was on the Moon which he studied for many years. He published in 1903 a photographic lunar atlas and marshalled evidence to show that minute changes occur and that rudimentary vegetation exists on the lunar surface. Assistant Professor at Harvard from 1890, he directed from 1900 onwards the Harvard station in Jamaica which became latterly his own private observatory. Independently of Lowell, he located the position of Pluto. He died January 21, 1938.

PINGRÉ, Alexandre Guy (1711-1796) born at Paris, (France), September 11, 1711, was educated for an ecclesiastical career. In 1746 he was appointed Astronomer to the Rouen Academy, and in 1751 returned to Paris. His chief work (1783-1784) was the Cometographie in which he recorded all comets ever observed from the early Chinese annals downwards. He also formed a table of eclipses. He died May 1, 1796.

PLANA, Giovanni Antonio Amadeo (1781-1864) born at Vogheri in Piedmont, (Italy), November 8, 1781, was educated in Paris and became Professor in Turin. His chief work, on the theory of the Moon's motion was published in 1832 in three volumes. He died January 20, 1864.



PLASKETT, John Stanley (1865- ) born at Woodstock, Ontario, (Canada), November 17, 1865, was educated at Toronto University. He became assistant Professor of Physics at Toronto in 1890, and joined the staff of the Dominion Observatory at Ottawa in 1905. He was chosen as Director of the Victoria Observatory, British Columbia in 1918. He has studied the massive and hot stars of type "O" and the interstellar clouds. He discovered in 1923 fixed lines of sodium in the spectra of many stars; and in 1928 independently of Lindblad and Oort, located the galactic centre.

PLASKETT, Harry Hemley (1893- ) son of above, born at Toronto, (Canada), July 1, 1893, was educated at Toronto University and became assistant to his father in 1919. He determined the temperatures of the hot stars of type "O". He went to the U.S.A. as Professor at Harvard in 1928, and to England in 1932 as Professor of Astronomy at Oxford.

POGSON, Norman Robert (1829-1891) born at Nottingham, (England), March 23, 1829, was trained as an optician. Assistant to J.R. Hind in London, and later at Radcliffe Observatory, Oxford, he was appointed in 1860 Government Astronomer at Madras. He discovered several variable stars, and between 1856 and 1868 seven asteroids. In 1850 he proposed the fixed scale of stellar magnitudes now in general use. Independently of Auwers, he discovered Nova Scorpii (1860). He died June 23, 1891.

POINCARE, Jules Henri (1854-1912) was born at Nancy, (France), April 29, 1854, and educated at Paris. He became lecturer at Caen, and held several mathematical professorships in Paris. His mathematical researches dealt with the tides, the rings of Saturn and cosmogony, and he wrote a number of important works on mathematical astronomy. He died July 17, 1912.

POND, John (1767-1836) was born in London, (England), and educated at Cambridge and on the Continent. He erected a private observatory at Westbury in Somerset. He succeeded Maskelyne as Astronomer-Royal of England in 1811. His careful measures for stellar parallax were negative. He retired in 1835, and died September 7, 1836.

PONS, Jean Louis (1761-1831) born at Peyre, Hautes-Alpes, (France), December 24, 1761, was appointed in 1789 caretaker at Marseilles Observatory. Instructed in astronomy by successive directors, he discovered 37 comets, among them that of 1818 proved by Encke to be periodic, and that of 1819, re-discovered by Winnecke in 1858 (Pons-Winnecke Comet). In 1813 he became assistant astronomer, and in 1819 Director of the Marlia Observatory. Later he was director at the Observatory at Florence where he died October 14, 1831.



PONTECOULANT, Philippe Gustave Doulcet de (1795-1874) born at Caen, (France), served in the Army in his youth and devoted himself to mathematical astronomy. He calculated to within three days the perihelion of Halley's comet in 1835. He died in Paris in 1874.

POUND, James (1669-1724) born in Wiltshire, (England), and educated at Oxford for the Anglican ministry, was appointed in 1707 Rector of Wansted in Essex. He observed the total eclipse of 1715, and along with his nephew, Bradley, attempted in 1717 to measure the solar parallax. They concluded that the Sun's distance lay between 93 and 125 million miles. He also observed the planets and double-stars. He died in 1714.

PRITCHARD, Charles (1808-1893) born at Alberbury, Shropshire, (England), February 29, 1808, was educated for the Anglican ministry and held teaching and clerical posts before his appointment as Professor of Astronomy at Oxford in 1870. He was the first to determine stellar parallaxes by means of photography. In 1885 he completed his photometric determination of the magnitudes of 2784 stars. He died May 28, 1893.

PROCTOR, Richard Anthony (1837-1888) born at Chelsea, London, (England), March 23, 1837, was educated at Cambridge where he graduated in 1860. Intended for a legal career, he abandoned law for astronomy, and made his first appearance as an author with his book on Saturn; other books followed in rapid succession. He observed Mars and constructed a map of the planet superior to all previous efforts. In 1870 he plotted on a single chart the 324,198 stars of Argelander's Durchmusterung and noticed the concentration of the bright stars to the galactic plane. He discovered the common proper motion of the stars of the Plough and drew attention to "star-drift" and "starstreaming". His work in cosmology led him to the conclusion that the stellar system was not only finite, but considerably smaller than previously supposed. He emigrated to America and settled in Missouri in 1881. He died September 12, 1888.

PUISEUX, Pierre Henri (1855-1928) born in Paris, (France), July 20, 1855, and educated at the Ecole Normal, joined the staff of the Paris Observatory and, in conjunction with Loewy, secured 6,000 photographs of the Moon and constructed the fine photographic atlas known by their names. He wrote the descriptions of the lunar formations and discussed their origin. After many years of ill-health, he died September 28, 1928.

PURBACH, Georg (1423-1461) born at Purbach, (Austria), May 30, 1423, became Professor in Vienna in 1450. He published a Latin version of Ptolemy's planetary theories, and an Epitome of Astronomy based on the Almagest which was completed after his premature death on April 8, 1461, by his friend and pupil, Regiomontanus.



QUENISSET, Ferdinand Jules (1872- ) born in Paris, (France), August 8, 1872, and educated in Paris, joined the staff of Juvisy Observatory in 1906. He discovered comets in 1903 and 1911. He has specialised in planetary photography, and secured in 1931 the first photographs of markings on Mercury.

QUETELET, Jacques Adolphe (1796-1874) born at Ghent, (Belgium), February 22, 1796, became a professor in Ghent College at the age of 18. He was appointed Director of the new Brussels Observatory in 1833, and published in 1839 his Catalogue of the Principal Appearances of Falling Stars. He first recognised the Perseid shower. He died February 17, 1874.

RAYET, Georges Antoine (1839-1906) born at Bordeaux, (France), December 12, 1839, was assistant in Paris Observatory, where he detected in 1867, along with Charles Wolf, the "Wolf-Rayet stars". He became Director of Bordeaux Observatory, and died on June 14, 1906.

REGIOMONTANUS, Johann Müller (1436-1476) was born on June 6, 1436, at Königsberg in Franconia, Germany, and derived his Latinised surname from his birthplace. Educated at Leipzig, he erected an observatory at Nuremberg. His astronomical Ephemerides were much superior to any previously published. He died July 6, 1476.

REID, William (1861-1923) born at Pitcaple, Aberdeenshire, (Scotland), emigrated to South Africa in 1901. He established a private observatory at Rondebosch, and discovered six comets. In 1920 he obtained visual evidence of the transparency of Saturn's rings. He died June 8, 1928.

REINHOLD, Erasmus (1511-1553) born at Saalfeld, Thuringia, (Germany), October 21, 1511, was Professor of Mathematics and Astronomy at Wittenberg from 1536 to his death on February 19, 1553. One of the first adherents of the Copernican system, he published in 1551 new tables of the celestial bodies on the basis of the new system, the Prutenic Tables, so-called because printed at the expense of the Duke of Prussia.

REINMUTH, Karl Wilhelm (1892- ) born at Heidelberg, (Germany), April 4, 1892, and educated at Heidelberg University, was assistant to Max. Wolf. He was appointed "chief observer" in 1937. He has discovered many asteroids, chief among them Apollo which approaches the Earth to within 3 million miles, and in 1937 Hermes with minimum distance of 700,000 miles. He has also discovered several comets.



RESPIGHI, Lorenzo (1824-1889) born at Corte Maggiore, Piancenzia, (Italy), October 7, 1824, and educated at Bologna, was Professor of Astronomy there from 1849 to 1865, when he was transferred to Rome. He discovered 3 comets (1862-1863). His chief work consisted in observing the solar prominences. He died at Rome, December 10, 1889.

RHETICUS, Georg Joachim (1514-1576) born at Feldkirch, (Germany), February 16, 1514, studied astronomy at Nuremberg and was appointed Professor of Astronomy at Wittenberg in 1536. A personal friend of Copernicus, he eagerly accepted the new system and prevailed on Copernicus to publish his great book. He calculated tables based on the Copernican system, published just before his death on December 4, 1576.

RICCIOLI, Giovanni Battista (1598-1671) born at Ferrara, (Italy), April 17, 1598, entered the Jesuit order and taught at Padua and Bologna. Although he rejected the Copernican system, he was a pioneer in telescopic work. He published Grimaldi's chart of the Moon, and affixed names to the chief lunar formations. He died June 21, 1671.

RICCÒ, Annibale (1844-1919) born at Modena, (Italy), September 15, 1844, and educated at Modena and Milan, became in 1873 Professor at Modena, and in 1879 at Palermo. Over a period of 33 years he observed and classified 21,533 solar prominences. Director of Catania Observatory on Mount Etna, from 1890, he died September 23, 1919.

RISTENPART, Friedrich Wilhelm (1868-1913) born at Frankfort, (Germany), June 8, 1868, and educated at Jena and Strasbourg Universities, was appointed assistant at Karlsruhe Observatory in 1891 and at Kiel in 1898. He joined the teaching staff of Berlin University in 1904, and did important work in practical astronomy, in the discussion of errors of observation. He went to South America to direct the Observatory at Santiago, Chile, and died on April 9, 1913.

RITCHIEY, George Willis (1864- ) born at Tupper's Plains, Ohio, (U.S.A.), December 31, 1864, was successively on the staffs of Yerkes, Mount Wilson and Washington Observatories. He figured the mirrors of the 60-inch and 100-inch reflectors. At Yerkes and Mount Wilson, he secured magnificent photographs of the Moon and the spiral nebulae.

ROBERTS, Alexander William (1858-1938) born at Farr, Sutherlandshire, (Scotland), December 4, 1858, was educated at Edinburgh University and Training College, and was appointed to the staff of Lovedale College, South Africa. Devoting his spare time to astronomy, he began in 1883 a systematic search for variable



stars, which was rewarded by many discoveries. He also determined the periods, light-curves and cause of variation of many variables. After his appointment as Senator of the Union of South Africa, he ceased active work in astronomy. He died, January 27, 1938.

ROBERTS, Isaac (1829-1904) born near Denbigh, North Wales, (England), on January 27, 1829, removed to Liverpool when a child, and later became a building contractor. He took up astronomy as a hobby when nearly 50 and erected private observatories at his home in Liverpool, and later at Crowborough, in Sussex. He did pioneer work in the photography of clusters and nebulae. He died July 17, 1904.

ROCHE, Edouard Albert (1820-1883) born at Montpellier, (France), October 17, 1820, was for many years Professor in the Academy of his native town. One of the most distinguished mathematical astronomers of his day, he investigated the origin of the Solar System. In 1848 he demonstrated that, in the case of satellite-systems, there is a limit within which a satellite cannot revolve intact; this limit, known as "Roche's limit" is equivalent to 2.44 times the planet's mean radius. He also proved that Saturn's rings are composed of innumerable meteoric particles. He died April 18, 1883.

RODÉS, Luis (1881-1939) born at Santa Coloma de Farnes, (Spain), December 31, 1881, and educated for the Jesuit Order, was Professor at Barcelona from 1906 to 1910, and became Director of the Ebro Observatory, Tortosa, in 1919. He was an assiduous observer of sun-spots, and determined the solar parallax by a new method, from stellar radial motions. He died June 7, 1939.

ROEMER, Olaus (1644-1710) born at Arhusen, Jutland, (Denmark), September 25, 1644, went to France in 1671, and worked at the Paris Observatory where, through his study of Jupiter's satellites, he discovered the velocity of light in space in 1675. He returned to Denmark in 1681 as Professor at Copenhagen. Among his numerous inventions, the chief were the transit instrument and the meridian circle, which contributed so largely to the advancement of exact astronomy. He died on September 19, 1710.

ROSENBERGER, Otto August (1800-1890) born at Tukkim, (Latvia), of German extraction, August 10, 1800, was assistant at Königsberg Observatory and later Professor at Halle. He predicted the perihelion passage of Halley's comet in 1835 with great accuracy. He died January 23, 1890.

ROSSE, William Parsons, third Earl of (1800-1867) born at York, (England), of an old Irish family, June 17, 1800, was educated



at Dublin and Cambridge. He erected in 1845 at his Irish home, Birr Castle, Ireland, a 72-inch reflector, for many years the greatest telescope in the world. With this instrument, he detected the spiral form of many nebulae; he also investigated star-clusters. He died October 31, 1867.

ROSSE, Lawrence Parsons, fourth Earl of (1840-1908) son of above, born at Birr Castle, (Ireland), November 17, 1840, continued his father's work on nebulae and was a pioneer in the measurement of lunar radiation. He died August 30, 1908.

ROSSELAND, Svein (1894- ) born at Norheimsund (Norway), March 31, 1894, and educated at Oslo and Copenhagen, worked at Mount Wilson, U.S.A., (1925-27), became Director of Oslo Observatory in 1928. He has investigated sun-spots and the bright-line stars.

ROWLAND, Henry Augustus (1848-1901) born at Honesdale, Pennsylvania, (U.S.A.), November 27, 1848, passed from engineering to physics and astronomy. He became Professor of Physics at Baltimore in 1876. His great map of the solar spectrum, published in 1895-1897, was the most elaborate of its kind, containing 20,000 lines. He died April 16, 1901.

ROYDS, Thomas (1884- ) born at Oldham, (England), April 11, 1884, and educated at Manchester, and later in Germany, went to India as assistant Director of Konaikadal Observatory, and became Director in 1923. He continued Evershed's work on solar physics. He retired in 1936 and returned to England.

RUSSELL, Henry Norris (1877- ) born at Oyster Bay, New York, (U.S.A.), October 25, 1877, was educated at Princeton, New Jersey. After a period of study under Ball at Cambridge, England, he succeeded Young as Director of Princeton Observatory in 1908. Independently of Hertzsprung, he showed in 1913 that the stars fall into two well-defined classes, giants and dwarfs, and he outlined a new theory of stellar evolution. He has devoted much attention to the evolution of the Solar System, the physical condition of the planets, and the composition of planetary atmospheres.

RUTHERFURD, Lewis Morris (1816-1892) born at Morrisania, New York, (U.S.A.), November 25, 1816, turned from the study of law to astronomy. He was one of the early pioneers of celestial photography and stellar spectroscopy. He died May 20, 1892.



SAFFORD, Truman Henry (1836-1901) born at Royalton, Vermont, (U.S.A.), January 6, 1836, was known in childhood as the "lightning calculator". He graduated at Harvard at the age of eighteen, and was appointed assistant at Harvard Observatory. He computed in 1861, the precise position of the companion of Sirius, discovered a few months later. He became Director of Chicago Observatory in 1866, and Professor at Williamstown College in 1876. He did important work on nebulae, and compiled a star-catalogue. He died June 13, 1901.

ST. JOHN, Charles Edward (1857-1935) born at Allen, Michigan, (U.S.A.), March 15, 1857, and educated at Harvard, became Professor of Physics at Oberlin College, Ohio, in 1893. He joined the staff of Mount Wilson Observatory in 1908. He became a leading authority on the Sun, re-determined the Sun's rotation by means of Doppler's principle, and studied the flow of gases out of and into sun-spots. In 1925 he detected traces of oxygen and water-vapour in the spectrum of Mars. He retired in 1930 and died April 26, 1935.

SAMPSON, Ralph Allen (1866-1939) born at Skull, County Cork, (Ireland), of English parentage, June 25, 1866, educated at Liverpool and Cambridge, was Professor of Mathematics at Newcastle (1893-1895), and of Astronomy at Durham (1896-1910). From 1910 to 1937, he was Astronomer-Royal for Scotland. His chief work was on the theory of Jupiter's four large satellites. He published in 1910 standard Tables of these bodies. He also investigated cosmological problems and devoted attention to clocks and time-keeping. He left Edinburgh in 1937 and died at Bath, November 7, 1939.

SANTINI, Giovanni (1786-1877) born at Caprese, Tuscany, (Italy), January 30, 1786, became assistant at Padua Observatory in 1806, and Director in 1813. He constructed a standard star-catalogue in 1840, and studied comets and asteroids. He died June 26, 1877.

SAUNDER, Samuel Arthur (1852-1912) born in London, (England) May 18, 1852, was educated at Cambridge for the teaching profession and became mathematical master at Wellington College. His chief work was on the Moon; he measured the positions of 3000 formations with great precision, and determined the heights of lunar mountains. He died December 8, 1912.

SAVARY, Felix (1797-1841) born in Paris, (France), October 4, 1797, became assistant at the Paris Observatory. He was the first to compute the orbit of a double star ( $\xi$  Ursae Majoris) in 1827. He died July 15, 1841.



SCHAEBERLE, John Martin (1853-1924) born at Herrenburg, (Germany), January 10, 1853, emigrated in childhood to America, and was Lecturer in Michigan University before joining the staff of the Lick Observatory in 1888. Ten years later he became Director of the Ann Arbor Observatory, Michigan. He investigated comets, the planets, and Jupiter's satellites; his most important discovery was that of the companion-star of Procyon in 1896. He died in September 1924.

SCHEINER, Christopher (1573-1650) born at Walda in Swabia, (Germany), and educated for the priesthood, became Professor of Mathematics at Ingolstadt. Later he was transferred to Innsbruck and Frieburg, and in 1620 was appointed Superior of the Jesuit College at Neisse in Silesia. His early observations with the newly-invented telescope led to his discovery of the solar spots, independently of Galileo and Fabricius. He determined the Sun's rotation period, and constructed a rudimentary map of the Moon. He died July 18, 1650.

SCHEINER, Julius (1858-1913) born at Cologne, (Germany), November 25, 1858, was educated at Cologne and Bonn, and became assistant to Schönfeld at Bonn Observatory in 1881. He joined the staff of Potsdam Observatory in 1887, and assisted Vogel in his work on stellar radial motion. He wrote a famous book on astronomical spectroscopy, published in 1890. He secured in 1899 a spectrogram of the Andromeda nebula, indicating its non-gaseous and presumably stellar nature. He became "chief Observer" at Potsdam in 1900. He died December 20, 1913.

SCHIAPARELLI, Giovanni Virginio (1835-1910) born at Savigliano in Piedmont, (Italy), March 14, 1835, was educated at Turin University. Intended for the profession of architecture, he abandoned this for astronomy. After three years' study in Germany and Russia under Encke and the Struves, he was appointed assistant in the Brera Observatory, Milan in 1860. He discovered in 1861 the asteroid Hesperia, and was appointed in 1862 Director of the Observatory. In 1866 he announced his first great discovery, the connection between comets and meteors, proving the identity of the orbit of the comet of 1862, with that of the Perseid meteors; he deduced correctly that meteors are the disintegrated fragments of comets. In 1877, he began the intensive study of Mars, discovered the famous "canals" and constructed charts of the planet, giving the surface-features the names by which they are still known. He proved in 1899 that the day of Mercury equals its year, and in 1890 and 1895 believed himself to have proved this in the case of Venus. He measured 11,000 double stars, and investigated the concentration of the stars to the galactic plane. Retiring in 1900 he devoted his remaining years to research in the history of astronomy and published in 1903 an authoritative volume on Old Testament astronomy and cosmology. He died at Milan, July 4, 1910.



SCHJELLERUP, Hans Karl Frederik Christian (1827-1887) born at Odense, (Denmark), February 8, 1827, was in early life a watchmaker. In 1851 he became assistant at Copenhagen Observatory. He computed planetary and cometary orbits, and compiled a star catalogue. In 1866 he published his well-known catalogue of red stars. He discovered and edited the MS of an important work by Al-Sufi, the ancient Persian astronomer. He died at Copenhagen, November 13, 1887.

SCHLESINGER, Frank (1871- ) born in New York, (U.S.A.), May 11, 1871, was observer in the "International Latitude Station" in California from 1899-1903, when he joined the staff of Yerkes Observatory. Director successively of Alleghany and Yale Observatories he has specialised in the measurement of stellar parallaxes by means of photography, determining the distances of 2000 stars with the greatest accuracy.

SCHMIDT, Johann Friedrich Julius (1825-1884) was born at Eutin in Lübeck, (Germany), October 25, 1825. At the age of 14 he began to observe the Moon and planned a chart of its surface. After completing his education at Hamburg he went to Altona Observatory, thence to Olmütz in 1853; he was appointed Director of Athens Observatory in 1858. The great lunar chart was completed in 1874, and published at Leipzig in 1878. He announced in 1866 a startling change in the appearance of the lunar crater Linné, and considerable controversy ensued. In 1876 he discovered the famous temporary star Nova Cygni. He died at Athens, February 8, 1884.

SCHÖNFIELD, Eduard (1828-1891) born at Hildburghausen, Meiningen, (Germany), December 22, 1828, was educated at Hanover and Cassel, with a view to architecture. At Marburg University his boyish interest in astronomy was revived and at Bonn he came under the influence of Argelander. Assistant to Argelander from 1854, he co-operated in the preparation of the Bonn Durchmusterung. Appointed Director at Mannheim in 1859, he returned to Bonn as Argelander's successor in 1875. He extended the Durchmusterung from  $-20^{\circ}$  south of the celestial equator, where Argelander left off, and surveyed all of the southern sky visible from Bonn, charting in all 133,659 stars. He also made many observations of variable stars and nebulae. He died at Bonn, May 1, 1891.

SCHRÖTER, Johann Hieronymus (1745-1816) born at Erfurt, (Germany), August 30, 1745, was trained at Göttingen University for the legal profession, and was appointed in 1778 chief magistrate of Lilienthal near Bremen. Here he erected an observatory in 1779, and later acquired a fine reflecting telescope by Herschel. For over 28 years he observed the Moon, and has been called "the founder of Selenography." He discovered the lunar "rills" and



measured the heights of many mountains. He carefully observed Mercury, Venus and Mars. During the Napoleonic War, his observatory was destroyed by French troops (1813). He died August 29, 1816.

SCHROETER, Jens Frederik Wilhelm (1857-1927) born at Oslo, (Norway), on May 21, 1857, graduated at Oslo University in 1882. He was for four years assistant at the Meteorological Institute. In 1891 he became observer at Oslo Observatory, and in 1919 Director. He investigated stellar proper motions, and published in 1923 his notable catalogue of solar eclipses visible in Europe. He died April 27, 1927.

SCHUMACHER, Heinrich Christian (1780-1850) born at Bramstedt, Holstein, (Germany), September 3, 1780, was educated for a legal career, but abandoned law for astronomy. He was successively Director of the Observatories at Mannheim, Copenhagen and Altona. He is chiefly remembered as the founder of the astronomical periodical Astronomische Nachrichten. He died December 28, 1850.

SCHWABE, Heinrich Samuel (1789-1875) was born at Dessau in Saxony, (Germany), October 25, 1789. Educated at Berlin University, he qualified as an apothecary, and set up in business in his native town. In 1826 he took up the study of astronomy as a hobby, and with the aid of a small telescope, he began to observe the Sun, counting the number of spots visible on every clear day. By 1843 he noticed a certain periodicity in the numbers, and in 1851 announced the discovery of the sun-spot cycle, which he fixed at 10 years. He died on April 11, 1875.

SCHWARZSCHILD, Karl (1873-1916) born at Frankfort, (Germany), October 9, 1873, and educated at Strasbourg and Munich Universities, was assistant in Vienna Observatory from 1896 to 1899. Later he became Director of Göttingen Observatory, and in 1909 of the Astrophysical Observatory, Potsdam. His earlier work was on photometry; while at Göttingen, he defined as the "colour-index" of a star the difference between its visual and photographic magnitude, and determined the colour-indices of 3500 stars. Later he occupied himself with the phenomenon of star-streaming, discovered by Kapteyn, and put forward the "ellipsoidal theory" in explanation of it. Military service during the Great War shattered his health and he died May 11, 1916.

SEARES, Frederick Hanley (1873- ) born at Cassapolis, Michigan, (U.S.A.), May 17, 1873, became in 1901 Director of the Laws Observatory and joined the staff of Mount Wilson Observatory in 1909. He investigated the visual and photographic magnitudes of stars and by means of their colour-indices, fixed their



"hypothetical spectra". His work in cosmology has been of outstanding importance. Along with van Rhijn, he computed the stellar population of the Galaxy (1925) and confirmed the existence of a local cluster (1928).

SECCHI, Angelo (1818-1878) was born at Reggio, in the Emilia, (Italy), June 29, 1818. Entering the Jesuit Order in his youth, he devoted himself to science from his youth. He was for a short time a science teacher in Georgetown College, U.S.A., and in 1849 was appointed Director of the Observatory of the Collegio Romano. His telescopic work, especially on Mars, was of a high order, and he became an authority on solar physics. He was a pioneer of stellar spectroscopy. He made the first spectroscopic survey of the stars (1864-1868). Examining and classifying the spectra of 4000 stars, he divided them into four types, known as "Secchi's types". He died at Rome, February 26, 1878.

SEE, Thomas Jefferson Jackson (1866- ) born near Montgomery, Missouri, (U.S.A.), February 19, 1866, and educated at Missouri University and Berlin, was assistant at Berlin, Yerkes and Lowell Observatories, and in 1899 was appointed Professor of Mathematics in the U.S. Navy. He was afterwards placed at the head of the Naval Observatory at Mare Island, California. He investigated the origin of double stars (1892), stellar evolution (1911) and the structure of the stellar system (1912). His work on double stars at the Lowell Observatory resulted in the discovery of many new pairs. He has also discussed the nature of gravitation.

SEELIGER, Hugo (1849-1924) born at Bielitz-Biala, in Silesia, (Germany), September 23, 1849, was educated at Heidelberg and Leipzig Universities. He was assistant to Argelander and latterly to Schönfeld at Bonn (1873-1881) and in 1881, became Director of Gotha Observatory. In 1882 he was transferred to Munich. He commenced in 1884 his long-continued researches into the structure of the stellar system, and in 1898 he computed the diameter of the system at 18,000 light years. In 1892 he advanced the "star-and-nebula" theory of the cause of temporary stars. He also studied double stars and the rings of Saturn. He died at Munich, December 2, 1924.

SHAPLEY, Harlow (1885- ) born at Nashville, Missouri, (U.S.A.), November 2, 1885, and educated at Missouri and Princeton Universities, worked at Princeton Observatory under H.N. Russell. In 1914 he advanced the "pulsation theory" of the Cepheid variables. In the same year, he was appointed to the staff of Mount Wilson Observatory, California, and with the aid of the 60-inch reflector, at once began his work on the globular star-clusters. He proved these to be dependants of the galactic system, situated



at distances ranging from 22,000 to 220,000 light-years. By means of the "period-luminosity law" of Cepheid variation, and by other reliable methods, he determined the diameter of the galactic system. His earlier figure of 300,000 light-years was later reduced by him to 100,000. He detected in 1918 the existence of a local cluster, consisting of the Sun and the nearby stars, and located the centre of the Galaxy among the star-clouds of Sagittarius. Incidentally he rehabilitated W. Herschel's disc-theory and showed the galactic system to be much larger than previously supposed. In 1921 he was appointed Director of Harvard College Observatory. His later cosmological work has confirmed his earlier, and he has investigated the external galaxies. He is the author of outstanding books on astronomy.

SIDGREAVES, Walter (1837-1919) born near Preston, (England), October 4, 1837, and educated at Stonyhurst College, joined the Jesuit Order, and became a member of the teaching staff at Stonyhurst, and Director of the Observatory. He specialised in the study of variable and temporary stars. He died June 12, 1919.

SLIPHER, Vesto Melvin (1875- ) born in Clinton County, Indiana, (U.S.A.), November 11, 1875, and educated at Indiana University, joined the staff of the Lowell Observatory in 1901. He did pioneer work on the spectra of the giant planets (1902) and obtained evidence of the presence of water-vapour in the atmosphere of Mars (1908). Along with Lowell he determined in 1912 the rotation period of Uranus. His measures of the radial velocities of the brighter "spiral nebulae" showed these objects to be receding with great speeds. He discovered that the nebula in the Pleiades and other diffuse nebulae shine by reflected star-light. He succeeded Lowell as Director of the Lowell Observatory in 1917.

SLIPHER, Earl Carl (1883- ) brother of above, born at Mulberry, Indiana, (U.S.A.), March 25, 1883, and educated at Indiana University, joined the staff of the Lowell Observatory in 1906. He took part in the Lowell expedition to the Andes in 1907 for observation of Mars, and co-operated with Lowell in his later work on that planet. His observations, visual and photographic, have invariably confirmed those of his chief, and gave "faithful support", he claimed in 1921, to Lowell's general conclusions. He has specialised in planetary photography, and his photographs of Venus, Jupiter and Saturn, as well as Mars, accumulated over many years, are of the highest value.

SMART, William Marshall (1889- ) born at Doune, (Scotland), March 9, 1889, and educated at Glasgow and Cambridge Universities, was Lecturer on Astronomy at Cambridge from 1919 to 1937, when he was transferred to Glasgow as Professor and Director of the Observatory. He has specialised in the study of stellar motions and galactic structure.



SMITH, Charles Michie (1854-1922) born at Keig, Aberdeenshire, (Scotland), July 13, 1854, brother of the famous Hebrew scholar W. Robertson Smith, was educated at Aberdeen and Edinburgh Universities. In 1876 he was appointed Professor of Physics at Madras Christian College, and in 1891 Government Astronomer in succession to Pogson. He established in 1899 the Observatory at Kodaikanal. He compiled the New Madras General Catalogue of 5303 stars, and devoted much attention to meteors. His chief work, however, was in solar astronomy, chiefly by means of the spectroheliograph. He retired in 1911 and died September 27, 1922.

SMYTH, William Henry (1788-1865) born in London, (England), January 21, 1788, served in the Navy in his youth, and rose to the rank of admiral. He established in 1830 a private observatory at Bedford, where he made observations on comets and other bodies. He was author of the Cycle of Celestial Objects. He died September 9, 1865.

SMYTH, Charles Piazzi (1819-1900) son of above, was born at Naples, (Italy), January 13, 1819, and named after G. Piazzi. He was assistant at the Cape (1835-1884) and Astronomer-Royal for Scotland (1844-1900). He measured lunar radiation, and made spectroscopic investigations of the Zodiacal light. He retired in 1889 and died February 21, 1900.

SNELL, Willibrord (1591-1626) born at Leyden, (Holland), succeeded his father as Professor of Mathematics in the University there. In 1617 he was the first to apply the trigonometric method for the measurement of the dimensions of the Earth, and made a remarkably accurate determination of an arc of the meridian. He discovered in 1620 the law of the refraction of light. He died October 30, 1626.

SOUTH, James (1786-1867) born in London, (England), in October 1786, was educated for the medical profession, which he abandoned for astronomy. He established a private observatory in Southwark, where he co-operated with John Herschel in the observation and measurement of double stars. Knighted in 1830, he died October 19, 1867.

SOLÁ, José Comas (1868-1937) born at Barcelona, (Spain), December 19, 1868, and educated there, became Director of Barcelona Observatory in 1903. In that year he detected a white spot on Saturn, and re-determined the planet's rotation period. He discovered two comets, one of them periodic (1927) and 11 asteroids. He died December 2, 1937.

SPÖRER, Friedrich Wilhelm Gustav (1822-1895) born in Berlin, (Germany), October 23, 1822, and educated at Berlin University,



entered the teaching profession, and was schoolmaster successively at Bromberg, Prenslau and Anclam, where he erected a private observatory. He discovered, in 1861, independently of Carrington, the equatorial acceleration. He also stated the law of sun-spot zones. Appointed assistant at Potsdam in 1874, he carried on spectroscopic work there for many years. He died at Giessen, July 7, 1895.

STEBBINS, Joel (1878- ) born at Omaha, Nebraska, (U.S.A.), July 30, 1878, was educated at Nebraska and Wisconsin Universities. He became assistant Professor of Astronomy in Illinois University in 1904, and Professor and director of the Observatory in 1910. He invented the selenium cell photometer in 1910, and applied it to astronomy. His investigations on star-clusters, completed in 1933, demonstrated the reality of interstellar light-absorption; he detected the reddening of the light of stars in those clusters nearest to the galactic plane, and computed the diameter of the galactic system at 100,000 light-years. He found the Andromeda galaxy to have a diameter of 80,000 light-years.

STONE, Edward James (1831-1897) born in London, (England), February 28, 1831, and educated at Cambridge, became chief assistant at Greenwich in 1860 and H.M. Astronomer at the Cape in 1870. He returned to England in 1879 as Radcliffe Observer at Oxford. His Cape Catalogue of 2892 stars, a standard work, appeared in 1878. He died May 9, 1897.

STÖRMER, Carl (1874- ) born at Skien, Norway, September 3, 1874, became in 1903 Professor in Oslo University. He measured the height of the auroral streamers, and ascertained the cause of the aurora. He has also investigated the nature of the solar corona.

STRATTON, Frederick John Marrian (1881- ) born at Birmingham, (England), October 16, 1881, and educated at Cambridge, became Professor of Astrophysics there and Director of the Solar Physics Observatory in 1928. He has specialised in the intensive study of novae and variable stars.

STRÖMBERG, Gustav (1882- ) born at Gothenburg, (Sweden), December 16, 1882, was educated at Gothenburg, Kiel, Stockholm and Lund. He was from 1906 to 1913 assistant at Stockholm Observatory. In 1917 he went to America and joined the staff of Mount Wilson Observatory, California. His first important work was on the luminosity of the long-period variable stars. His work on the radial motions of stars and nebulæ led to his striking discovery, announced in 1923, of the "assymetry of stellar motions" explicable on the Lindblad-Oort theory of galactic rotation, enunciated soon afterwards.



STRÖMGEN, Svante Elis (1870- ) born at Helsingborg, (Sweden), May 31, 1870, and educated at Kiel and Lund, became Director of Copenhagen Observatory in 1907. His long-continued work on comets led him to the view that these bodies have always belonged to the Solar System.

STROOBANT, Paul Henri (1868-1936) born at Ixelles, (Belgium), April 11, 1868, began the study of astronomy in boyhood. He became Assistant at Uccle Observatory, Brussels, in 1891. He was appointed assistant Director in 1918 and Director in 1925. His work embraced the asteroids, Saturn's rings, the solar motion and stellar distribution. He was one of the first astronomers to point out the existence of the "local cluster". He died at Brussels, July 15, 1936.

STRUVE, Friedrich Georg Wilhelm (1793-1864) born at Altona, near Hamburg, (Germany), April 15, 1793, the son of a distinguished schoolmaster, went to Estonia, then part of the Russian Empire, and entered Dorpat University. He specialised in astronomy and was in 1818 appointed Director of Dorpat Observatory. Securing in 1824 a 9-inch refractor by Fraunhofer, driven by clockwork, he commenced the study of double stars and discovered 2200 new pairs. He attacked the problem of star-distance, independently of Bessel and Henderson, and measured the parallax of Vega; his measures were announced in 1840. In 1839 he was summoned to Pulkova, Russia, to direct the new Imperial Observatory there. About 1845 he began his work on cosmology. Rejecting W.Herschel's disc-theory, he advanced the hypothesis of a stellar system infinitely extended in the galactic plane. He also assumed that the light of the most distant stars was rendered invisible by absorption. In 1861 he retired and he died on November 23, 1864.

STRUVE, Otto Wilhelm von (1819-1905) son of above, born at Dorpat, (Estonia), May 7, 1819, became assistant to his father while still a student at Dorpat University. He accompanied his father to Pulkova in 1839. His chief work was on double stars; he also re-determined the direction and speed of the solar motion. Among his other investigations must be mentioned his study of Saturn's ring-system, and the measurement of stellar parallaxes. As an observer and discoverer of double stars, his fame is only second to that of his father; in all he discovered 547 pairs. He succeeded his father as Director of Pulkova Observatory in 1861. He retired in 1889 and returned to Germany. He died at Karlsruhe, April 14, 1905.

STRUVE, Karl Hermann (1854-1920) son of above, was born at Pulkova, (Russia), October 3, 1854. Educated at Dorpat University and later in France and Germany, he became assistant to his father at Pulkova. He carried through micrometrical measures of



the satellites of Mars, Neptune and Saturn. He was appointed in 1895 Professor at Königsberg and in 1904 Director of Berlin Observatory, which was reorganised by him and transferred to Babelsberg during his tenure of office. Here he continued his work on Saturn's satellites. He died August 12, 1920.

STRUVE, Gustav Wilhelm Ludwig (1858-1920) brother of above and son of Otto Struve, was born at Pulkova, (Russia), November 1, 1858. After acting as assistant to his father, he went to Dorpat in 1886, and to Kharkov as Director of the Observatory there in 1894. His chief work was on the solar motion, which he re-determined, and in related problems of statistical astronomy. He died November 4, 1920.

STRUVE, Otto (1897- ) son of above, born at Kharkov, (Russia), on August 12, 1897, and educated at Kharkov, emigrated to America after his father's death. He studied at Chicago University and was appointed to the staff of the Yerkes Observatory in 1921. He became Professor of Astronomy in Chicago University and Director of the Yerkes Observatory in 1932. His chief work has been on the interstellar calcium clouds, the nebulae and the rotation of the stars. In 1937 he investigated the star Epsilon Aurigae and concluded its diameter to be 2600 million miles.

SWIFT, Lewis (1820-1913) born at Clarkson, New York, (U.S.A.), on February 29, 1820, was engaged in early life in the hardware trade and turned to astronomy as a recreation. In 1882 he became Director of a private observatory at Rochester, New York, and later of another in the San Gabriel Mountains in California. He discovered 13 comets including the comet of 1862, and 900 nebulae. He died January 4, 1913.

TACCHINI, Pietro (1838-1905) born at Modena, (Italy), March 21, 1838, and educated at Modena University, became Director of Modena Observatory in 1859. He was transferred to Palermo in 1863, and in 1879 succeeded Secchi as Director of the Observatory of the Collegio Romano. A pioneer of solar spectroscopy, he paid special attention to the prominences and showed that they obey the 11-year period. He observed several total eclipses, and investigated the rotation of Venus (1895). He retired in 1902, and died at Modena, March 19, 1905.

TEBBUTT, John (1834-1916) born at Windsor, New South Wales, (Australia), May 25, 1834, erected at the age of 20 a private observatory in his native town. He discovered the great comet of 1861, and the comet of 1881, which bears his name. He died in November 1916.



TEMPEL, Ernst Wilhelm Liebrecht (1821-1889) born at Lobau, Saxony, (Germany), December 4, 1821, endured extreme poverty in youth, and after travelling in various countries, settled in Italy, and became observer in Venice Observatory. Here he discovered in 1859 the nebula in the Pleiades. Later he was employed in Marseilles Observatory but settled finally in Italy in 1871. He was assistant at Milan and was afterwards transferred to Arcetri Observatory, Florence. He discovered five asteroids and several comets. He died March 16, 1889.

TERBY, François Joseph Charles (1846-1911) born at Louvain, (Belgium), August 8, 1846, and educated at Louvain University, established a private Observatory where he studied the planets for many years. His memoir on Mars discussed all Martian observations made from 1638. He studied also the Sun and comets. He died March 20, 1911.

TISSERAND, François Félix (1845-1896) born at Naintry-sur-Georges, (France), January 13, 1845, joined the staff of the Paris Observatory in 1866. He became Director of Toulouse Observatory in 1870 and returned to Paris as Director in 1892. He was primarily a mathematical astronomer, and investigated the Moon's motion, the orbits of comets and other subjects. He died October 20, 1896.

TROUVELOT, Étienne Leopold (1827-1895) born at Guyencourt, (France), December 26, 1827, emigrated to America in 1858. He became assistant at Harvard Observatory, where he observed the planets and the Sun, specialising in the study of the solar prominences. He returned to France as assistant to Janssen at Meudon, and continued his prominence work. He died April 22, 1895.

TRUMPLER, Robert Julius (1886- ) born at Zurich, (Switzerland), October 2, 1886, was educated at Zurich University, and was from 1915 astronomer to the Swiss Geodetic Survey. He went to America in 1915 as assistant at Alleghany Observatory, and was transferred to the Lick Observatory in 1919. There he specialised in the study of Mars and stellar clusters. In 1924 he observed Mars carefully, and confirmed the linear nature of the canals. In 1930 as the result of his study of star-clusters he secured irrefutable evidence of the existence of intergalactic light-absorption.

TURNER, Herbert Hall (1861-1930) born at Leeds, (England), August 13, 1861, and educated at Cambridge, became chief assistant at Greenwich in 1884, and Professor of Astronomy at Oxford in 1893. He discovered the temporary star (Nova Geminorum) of 1903, and put forward a hypothesis to account for Kapteyn's star-streams. He invented the word "parsec" to designate the distance represented by a parallax of one second of arc. He died August 20, 1930.



VAN BIESBROECK, Georges Achille (1880- ) born at Ghent, (Belgium), January 21, 1880, was assistant successively at Heidelberg, Potsdam and Uccle Observatories and emigrated to America in 1915; he became assistant in the Yerkes Observatory and Professor in Chicago. He has discovered several comets and investigated comets, the planet Mars and double stars.

VAN DER BILT, Jan (1876- ) born at Kapelle b. Goes, Zeeland, (Holland), April 23, 1876, joined the staff of Utrecht Observatory. He became a leading authority on double and variable stars.

VAN MAANEN, Adriaan (1884- ) born at Sneek, Friesland, (Holland), March 31, 1884 and educated at Utrecht and Groningen, emigrated to America in 1911 and joined the staff of the Yerkes Observatory. He was appointed in 1912 to Mount Wilson. He has carried through extensive surveys for stellar parallaxes, and determined many proper motions. In 1917 he discovered a very faint white dwarf star ("Van Maanen's star") and in 1918 and 1933 determined the distances of several planetary nebulae.

VAN RHIJN, Pieter Johannes (1886- ) born at Gouda, (Holland), March 24, 1886, and educated at Groningen University, became an astronomer through the influence of Kapteyn. He went to America in 1912 and joined the staff of Mount Wilson Observatory where he carried through an important investigation on the brightness of the night sky and concluded that the Zodiacal Light probably extends over the whole sky. In 1914 he returned to Holland as assistant to Kapteyn at Groningen. He collaborated with Kapteyn in his later studies of the structure and extent of the Galaxy. He succeeded Kapteyn in 1921 as Professor of Astronomy at Groningen and Director of the Astronomical Laboratory. In 1925, in co-operation with Seares, he completed an exhaustive enumeration of the stars, and computed the stellar population of the Galaxy to be 30,000 million.

VERY, Frank Washington (1852-1927) born at Salem, Massachusetts, (U.S.A.), February 12, 1852, and educated at Boston, was employed successively at Alleghany, Lowell and Westwood Observatories. He investigated lunar radiation and the atmosphere of Mars, and in 1911 resuscitated the "island universe" theory of the spiral nebulae. He died November 25, 1927.

VOGEL, Hermann Carl (1842-1907) born at Leipzig, (Germany), April 3, 1842, was educated at Leipzig University and while still a student, was assistant in the Observatory. He assisted Zöllner in his work on the solar prominences, and in 1870 became Director of a private observatory at Bothkamp where he did pioneer work on stellar radial motions. He joined the staff of Potsdam Observatory in 1874 and was Director from 1882. He



showed in 1889 that the variations of Algol were due to periodical eclipses and in 1890 he detected the duplicity of Spica, thus establishing the existence of spectroscopic binary stars. He revised Secchi's classification of stellar spectra in 1874 and arranged the stars in an "evolutionary sequence", and in 1883 he published the first spectroscopic star-catalogue. He died at Potsdam on August 14, 1907.

WARGENTIN, Pehr Vilhelm (1717-1783) born at Sunne Prestgard, (Sweden), on September 22, 1717, and educated at Upsala University, was for many years Director of Stockholm Observatory. He observed lunar eclipses, and published in 1746 extremely accurate tables of Jupiter's satellites. He died December 13, 1783.

WATSON, James Craig (1838-1880) born at Fingal, Ontario, (Canada), January 28, 1838, settled in Michigan in early childhood and was for some time a factory hand. Later he entered Michigan University and became Professor at Ann Arbor in 1863. He discovered 22 asteroids between 1863 and 1877. He was appointed Director of Washburn Observatory in 1879, and died November 22, 1880.

WEINEK, Ladislaus (1848-1913) born at Ofen, Budapest, (Hungary), February 13, 1848, was observer at Leipzig from 1875 to 1882, and in 1883 became Director of the Observatory at Prague. One of the pioneers of lunar photography, he published an excellent photographic atlas of the Moon. He died November 12, 1913.

WEBB, Thomas William (1807-1885) born at Lichfield, (England), December 14, 1807, and educated at Oxford, entered the ministry of the Church of England, and became rector of Hardwick in 1854. A distinguished amateur observer, his Celestial Objects for Common Telescopes (1859) long enjoyed a wide popularity. He died May 19, 1885.

WEISS, Edmund (1837-1917) born at Freivaldau, Silesia, (Germany), August 26, 1837, studied at Vienna, and became assistant at the observatory in 1858, and Director in 1878. He investigated the connection between comets and meteors, in demonstrating which he took a prominent part. He predicted the shower of meteors, remnants of Biela's comet, which took place in 1872. He died June 21, 1917.

WILDT, Rupert (1905- ) born at Munich, (Germany), June 25, 1905, and educated at Berlin University, was assistant at Bonn Observatory from 1928 to 1929, and at Göttingen from 1929 to 1935. He detected in 1932 the presence of ammonia and methane in the atmosphere of Jupiter. He went to America in 1935, and was research assistant at Mount Wilson till 1936, and at Princeton from 1937.



WILLIAMS, Arthur Stanley (1861-1938) born at Brighton, (England), was trained as a solicitor, and gave his spare time to astronomy. A skilful observer, his work on the planets Mars, Jupiter and Saturn was of high order. He discovered numerous variable stars and observed several novae. He died at Feock, Cornwall, November 21, 1938.

WILSON, Alexander (1714-1786) born at St. Andrews, (Scotland), became in early life a typefounder. His interest in astronomy led to his appointment as Professor of Astronomy at Glasgow in 1760. He carefully observed the Sun, and advanced his famous theory of the spots as openings in the photosphere. He died in Edinburgh, October 18, 1786.

WINNECKE, Friedrich August Theodor (1835-1897) born at Grossheere, Hildesheim, (Germany), February 5, 1835, a Lutheran minister's son, was educated at Hanover and Göttingen. He worked for a time under Argelander at Bonn, where he discovered the short-period comet known by his name. He also measured the distance of one of the nearer stars "Lalande 21,185." He was also a keen observer of variable stars. He worked at Pulkova under the Struves, until 1865 and married Otto Struve's daughter. He was appointed Director of Strasbourg Observatory in 1872, but suffered a mental breakdown in 1881. He died December 2, 1897.

WITT, Karl Gustav (1866- ) born in Berlin, (Germany), October 29, 1866, became Director of the Urania Observatory in Berlin in 1901. He discovered in 1898 the small asteroid Eros, which was found to approach within 13 million miles of the Earth.

WOLF, Charles Joseph Étienne (1827-1918) born at Vorges, near Laon, (France), November 9, 1827, of an Alsatian family, became Professor at Montpellier in 1856, and joined the staff of the Paris Observatory in 1862. His most famous discovery (1867), made in conjunction with his pupil Rayet, was that of a rare class of stars with bright-line spectra, known as "Wolf-Rayet stars". He investigated problems of cosmogony, and wrote a history of the Paris Observatory. He died July 4, 1918.

WOLF, Maximilian Franz Joseph Cornelius (1853-1932) better known as Max Wolf, born at Heidelberg, (Germany), June 21, 1863, the son of a distinguished medical man, was educated at Heidelberg and Stockholm Universities. At the age of 16 he began the study of astronomy, and had a small observatory in his father's garden. While still a student, he became famous by his discovery of a periodic comet (Wolf's comet) in 1884. He was the first to apply photography to the discovery of asteroids. He detected his first asteroid by this method in 1891, and in all he discovered about 1300 of these objects. In 1893 he was appointed to a special professorship of Astrophysics and Director of the new



observatory on the Königstuhl, Heidelberg; in 1902 he became Professor of Astronomy. His photographs of the Milky Way revealed an unsuspected profusion of nebulous matter and dark spaces which he later interpreted as great clouds of cosmical dust, obscuring the light of the stars behind. He discovered many new nebulae and published a classification of nebulous objects. He discovered in March 1901 a "nebelhaufen" or cluster of nebulae, now known to be external galaxies. In the same year he photographed the nebulae round Nova Persei. He discovered, July 30, 1927, a temporary star in Aquila (Nova Aquilae No.4). He died at Heidelberg, October 3, 1932.

WOLF, Rudolf (1816-1893) born at Zurich, (Switzerland), July 7, 1816, was successively Director of Berne and Zurich Observatories. He confirmed Schwabe's discovery of the sun-spot period, and fixed it more accurately at 11.1 years. He announced in 1852 the identity of the sun-spot and terrestrial magnetic cycles and the synchronisation of aurorae with solar disturbances. He also studied variable stars. Perhaps his chief title to fame is as a historian; his Geschichte der Astronomie is regarded as a classic. He died at Zurich, December 6, 1893.

WOLFER, Heinrich Alfred (1854-1931) born at Schonenberg near Zurich, (Switzerland), January 27, 1854, became assistant to Rudolf Wolf and devoted himself to planetary observation. His chief work was on the Sun and after he succeeded Wolf as Director in 1893, he became a leading authority on sun-spots. Charts were issued during his directorship of all the happenings on the photosphere during each solar cycle. He retired in 1926 and died October 8, 1931.

WRIGHT, Thomas (1711-1785) born near Durham, (England), September 22, 1711, was in early life a clock-maker's apprentice, then went to sea, and afterwards became a mathematical teacher. In 1750 he published his Original or New Hypothesis of the Universe, in which he outlined a "disc-theory" strikingly similar to that afterwards put forward by Herschel. He gave the correct explanation of Saturn's rings as composed of innumerable meteorites. He died February 25, 1786.

WRIGHT, William Hammond (1871- ) born in San Francisco, (U.S.A.), on November 4, 1871, and educated in his native city and at the University of Chicago, joined the staff of the Lick Observatory in 1897. He has carefully studied the planetary nebulae and showed in 1914 that the nuclei of these are Wolf-Rayet stars. In 1929 he secured photographs of Mars through coloured screens, and found that the Martian atmosphere is at least 120 miles in depth and of greater density than formerly supposed. He was appointed Director of the Lick Observatory in 1935.



YOUNG, Charles Augustus (1834-1908) born at Hanover, New Hampshire, (U.S.A.), December 15, 1834, and educated at Dartmouth College, became Professor at Dartmouth in 1865 and at Princeton in 1877. One of the most persistent observers of the Sun by spectroscopic means, he discovered the "reversing layer" during the total eclipse of 1870. He observed on September 7, 1871, one of the most famous of all solar eruptions, when a prominence rose to a height of 200,000 miles. He was the author of many standard works on astronomy, chief among them General Astronomy and The Sun. He retired in 1905 and died on January 2, 1908.

ZACH, Franz Xavier von (1754-1832) born at Pressburg, (Hungary), June 4, 1754, travelled extensively in early life and became in 1786 Director of Seeberg Observatory, near Gotha. He took a leading part in the search for a "missing planet" between Mars and Jupiter. This object - the asteroid Ceres - was re-discovered by him on December 31, 1801. He did much for the promotion of international co-operation among astronomers. He died September 4, 1832.

ZANSTRA, Herman (1894- ) born at Heerenveen, Friesland, (Holland), November 3, 1894, was educated at Amsterdam, and held appointments in London and at Seattle, U.S.A., before his appointment as Radcliffe Travelling Fellow of the University of Oxford, and observer at the new Radcliffe Observatory, Pretoria, South Africa. He has investigated the spectra of comets, and in 1930 determined the temperatures of the central stars of planetary nebulae, ranging from 28,000 to 140,000 degrees.

ZEIPEL, Hugo von (1873- ) born at Osterhanninge, (Sweden), February 8, 1873, and educated at Stockholm, was assistant at Pulkova, Russia, from 1901 to 1903, and at Upsala from 1903 to 1919. He carried through an exhaustive study of the Hercules cluster, published in 1913, and is a leading authority on star-clusters generally. He became in 1919 Professor of Astronomy at Upsala and Director of the Observatory.

ZÖLLNER, Johann Carl Friedrich (1834-1882) born at Leipzig, (Germany), November 8, 1834, was educated at Leipzig and Berlin Universities. He was appointed Professor of Astronomy at Leipzig in 1874. Three years earlier he had succeeded in observing the forms as well as the spectra of solar prominences without an eclipse, and thus made possible the daily observation of these objects. He was the author of the theory, now abandoned, that the giant planets are in a more or less sunlike condition. As the result of his early spectroscopic observations, he was the first to suggest that the various spectral types represented an evolutionary sequence. He died at Leipzig on April 25, 1882.



ZUCCHI, Niccolo (1586-1670) born at Parma, (Italy), December 6, 1586, entered the Jesuit order and became a Professor in the Collegio Romano. He was the first to suggest the possibility of constructing a reflecting telescope. One of the earliest planetary observers, he observed the belts of Jupiter in 1630. He died May 21, 1670.

ZWICKY, Fritz (1898- ) born at Varna, (Bulgaria), February 14, 1898, went to Switzerland in youth and held a teaching appointment in Zurich. Emigrating to America, he became Associate Professor of Physics at the Californian Institute of Technology and observer on Mount Palomar. He has specialised in the study of the external galaxies and since 1936 has discovered 36 supernovae in these systems.



A NOTE ON THE COMPILER.

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MACPHERSON, Hector Copland (1888- ) born in Edinburgh, (Scotland), April 1, 1888, graduated M.A. (1912) and Ph.D. (1923) at Edinburgh University. Ordained to the Presbyterian ministry in 1916, he was Lecturer on Natural Science at Aberdeen College in 1925 and on Astronomy at the Royal Technical College, Glasgow, from 1928 to 1938. A specialist in astronomical history, his chief books have been on the development of cosmology and the inter-relations of science and religion.



#### A NOTE ON THE SOURCES.

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The sources which the compiler has consulted in the preparation of this work are too numerous to be mentioned in detail. Chief among them may be mentioned the several editions of Poggendorff's Handwörterbuch: Porträtgallerie der Astronomischen Gesellschaft, Obituary Notices of astronomers in Monthly Notices, R.A.S. (Annual Reports), The Observatory, Popular Astronomy and L'Astronomie, notices of R.A.S. Gold Medallists in B.A.A. Journal, Who's Who, Who's Who in America, Dictionary of National Biography, Chambers' Biographical Dictionary of Eminent Scotsmen, Biographie Universelle (Michaud) Allgemeine Deutsche Biographie (Dunder and Humblot) Dictionary of American Biography, Who's Who in the Moon (B.A.A.) Gill's History of the Cape Observatory and authoritative works on astronomical history and biography.

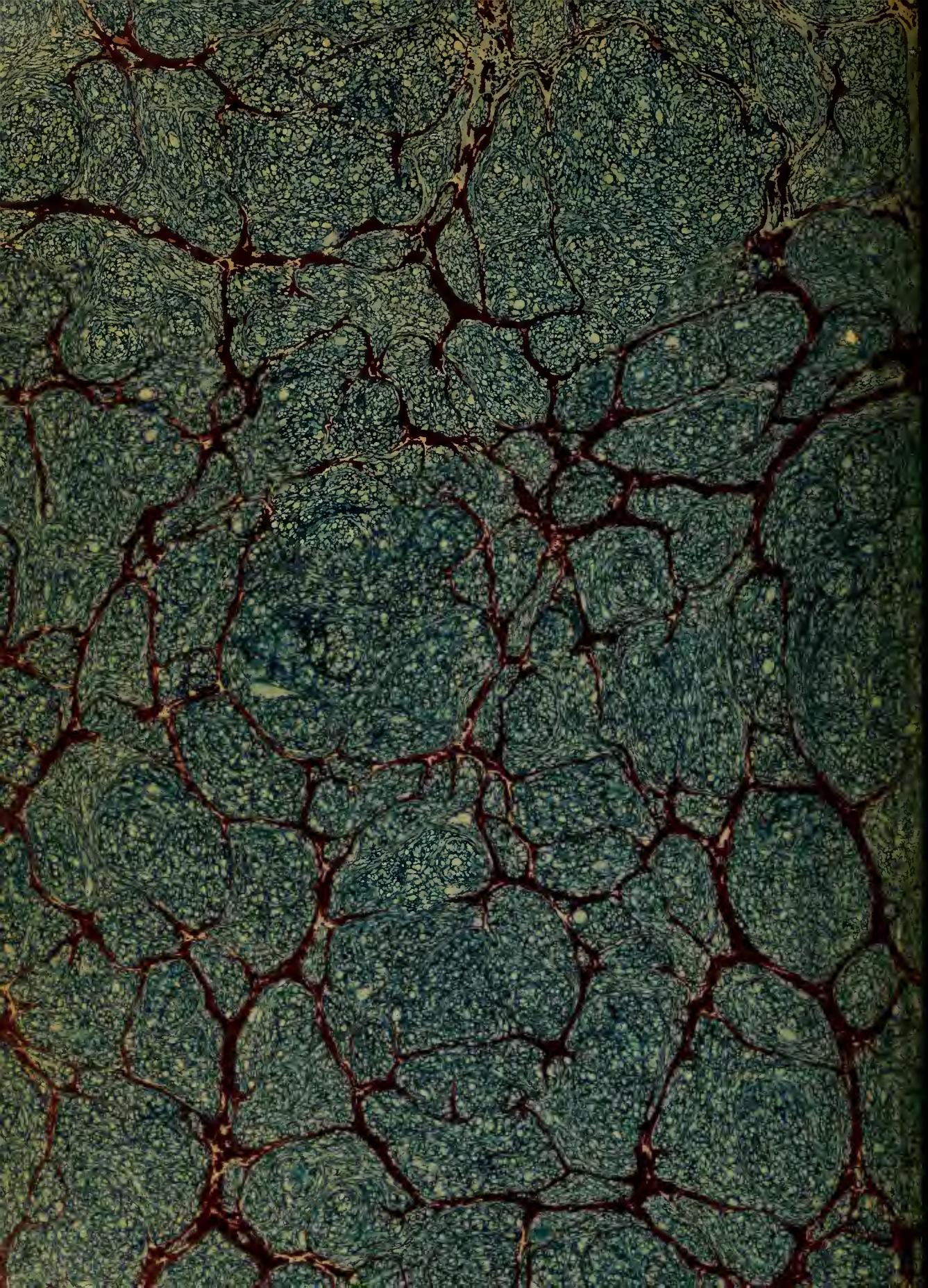
Information has been also supplied by many contemporary astronomers whose courtesy and helpfulness the compiler desires to acknowledge.











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